SCIENTIFIC AMERICAN

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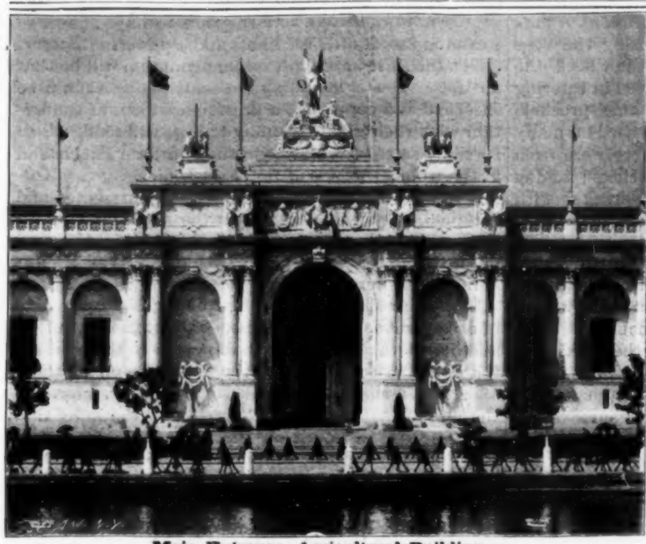
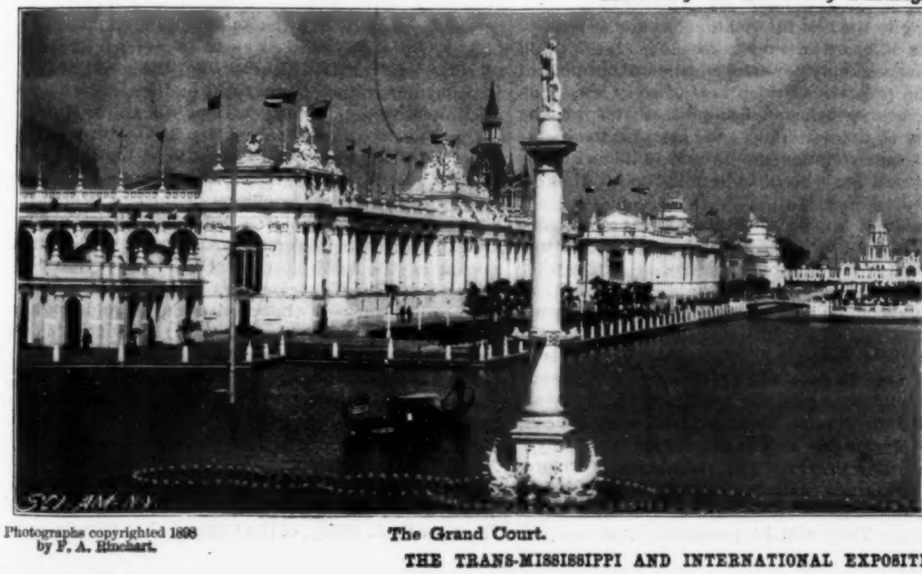


Main Entrance, Agricultural Building

Liberal Arts.

Machinery and Electricity Building.



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The Grand Court.

Group in Streets of All Nations.

THE TRANS-MISSISSIPPI AND INTERNATIONAL EXPOSITION.—[See page 138.]

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THE INCREASING WEIGHT OF THE BICYCLE.

In spite of the steady advance that marks the development of the bicycle, there is one particular in which, during the past two or three years, there has been a decided retrogression. We refer to the all-important question of weight.

We use the term "all-important" advisedly; for it is a fact that, in the advance which has taken place during the past half century in engineering construction, the remarkable reduction of dead weight, whether it be in a steel bridge or a buggy, is quoted as one of the most striking evidences of our "end of the century" development. Mediocre construction of the rule-of-thumb order is satisfied if the structure accomplishes the end in view; but thoroughly scientific engineering, whether civil or mechanical, seeks to secure the same end with the least possible expenditure of material or increase of bulk or weight. It is this combination of lightness and strength that gives strong national individuality and much of its superior merit to the engineering work which is turned out in this country.

This good feature was formerly one of the best characteristics of the American bicycle, and, up to the years 1895 and 1896, there was a steady decrease in the weight of each season's wheels, the standard makes in these years being many pounds lighter than those of foreign manufacturers. It was largely the light weight of the domestic wheel that brought the heavier and clumsier foreign wheels into disfavor and practically drove them out of the market.

It is to be regretted, we think, that the wheels of the last two or three seasons have shown a steady increase in weight, and this, in spite of the fact that the constant improvements in the manufacture of steel make it possible to use less material to secure the same margin of strength. In 1895 and 1896 the public demand for light wheels had resulted in the production of racing wheels that weighed from 17 to 18 pounds, light roadsters of from 20 to 22 pounds, and heavy roadsters, equipped with brakes, of from 23 to 25 pounds; but in 1898 we find that racing wheels weigh 20 to 22 pounds, light roadsters 23 pounds, and the ordinary roadsters from 25 up to 28 and even 29 pounds.

Now this is a decided step in the wrong direction. From a structural point of view, there is no excuse for it; for the improvement in the materials of construction gives the public a full right to expect that, instead of growing heavier, the bicycle will grow steadily lighter.

The manufacturers attribute the increase in weight to various causes. Some makers state that the light wheels of 1895 were due to special care in manufacture, and that work and materials that were put into a $125 machine cannot be expected in one that is sold for $50. Others do not hesitate to attribute the change to a demand on the part of the public for a heavier wheel; while there are other makers who hold that the increased weight is due to the introduction of altogether new features into the wheel itself.

We are inclined to think that most of the added weight is due to changes in the construction of the wheel, some of which have been introduced for strength and others being due to the caprice of the public. Among the former sources of weight we might mention the extra length of the reinforcements at the joints; the larger diameter of the hubs, crank hangers, and bearings; the increased amount of metal involved in the use of the divided and bushed crank axles; the very considerable increase in weight due to the rage for larger and, therefore, heavier sprockets, involving a very considerable increase in the length and weight of the chain; the complete reinforcement of the head for its whole length, and the great lengthening of the fork reinforcement; and the tendency, while maintaining the large diameter tubing, to increase its gage, in order to prevent bruising or indentation.

Now it may be taken for granted that as long as the public is satisfied with the heavier bicycles, there will be no disposition upon the part of the manufacturers to make them lighter. The question of weight being eliminated, the builder will make it his first care to put up a wheel that will carry its rider through a maximum amount of rough usage. The makers understand well that a positive breakdown in the way of broken forks, twisted wheels, or a buckled frame works more damage to their reputation than any other form of failure, and it is certain that a reduction in the amount and weight of material put into the bicycle will never be made by the manufacturers on their own initiative. It will only be done in response to the demand of the bicycling public.

There is not the slightest doubt that the weight of the bicycle of to-day could be brought down to and below that of 1895-96 without impairing the *needful* strength of the machine. This could be accomplished partly by throwing out certain useless fashions or fads in the present machine and partly by using the very highest quality of steel in all parts of the wheel. As an instance of unnecessary weight involved in catering to a popular fad, we might mention the large sprockets of thirty teeth and over which are being used on many machines. In the era of light wheels there were from sixteen to twenty teeth in the front sprockets; to-day an up-to-date wheel will carry a front sprocket with from twenty-six to thirty-two teeth and a rear sprocket large in proportion. This means an increase in weight due to from 10 to 12 inches of increased periphery in the sprocket and an increase in the length and weight of the sprocket disk or spokes in addition to the weight due to lengthening the chain by 6 to 8 inches.

The large sprocket fad is not altogether based on sound mechanical theories; for, while the tension in the chain is less, its speed is greater, and the friction due to its more rapid passage around the sprockets is proportionately increased. That the mechanical gain is more imaginary than real is borne out by the fact that the racing men, even those who are using gears of from 100 to 112, are all returning to sprockets of moderate size.

The increasing size and thickness of the barrel hubs is also answerable for some of the added weight, and a glance at many of the crank hangers shows that here also several ounces have been added in the last two or three years. The increase in the length of the cranks from 6½ to 7 and 8 inches, due to the craze for higher gears, has added its quota of weight, and something must be put down to the abnormally wide handle bars which are just now the vogue.

It is strange that no maker has succeeded in introducing a feature into the bicycle frame which is not only thoroughly scientific, but would undoubtedly strengthen it, and at the same time allow a certain reduction in its weight. We refer to the introduction of a cross tie or strut within the frame, running either from the joint at the seat-post to the joint at the bottom of the head or from the top of the head to the crank-hanger. The introduction of such a member would make the frame what it certainly is not at present—a truss. It would cause all the strains, whether of tension or compression, to act along the axis of each tube, and it would have the important result of relieving the tubes at the joints of all bending strains acting in the plane of the frame. This would remove the necessity for much of the reinforcement at the joints and would necessarily lighten the structure. A pair of wires joining opposite angles of the frame, each provided with a neat little turnbuckle, would have at once a remarkable stiffening and lightening effect on the whole wheel. Popular taste, however, would probably object to the innovation.

Light weight is to-day, and ever will be, one of the most valuable considerations in the bicycle. The seven or eight pounds which could be taken off the present wheel would make a world of difference in an all day ride, especially in the latter part of the journey. Weight, as we have suggested, is not necessary to rigidity, and its present rapid increase in the bicycle is a distinctly retrograde step on the part of both the manufacturer and the public.

PROBABLE INCREASE OF THE NAVY.

According to the best information at hand, it is likely that the naval board will make recommendations calling for an exceedingly powerful addition to our present navy. The provisions, which are in every way commendable, bear evidence of being directly inspired by the lessons of the war, and we are gratified to observe that the recommendations are directly in line with suggestions which have been made from time to time by this journal.

The report of the board will probably recommend the construction of three battleships of 13,000 tons displacement and a minimum speed of 18½ knots when the ships are at their deepest draught, with a full load of stores and coal on board. They are to have a cruising radius of 8,000 knots, or sufficient to carry them to Manila without recoaling. The main battery is to consist of four 12-inch rifles of great length, to suit the new smokeless powder, and fourteen or sixteen 6-inch rapid-fire guns. There will also be a heavy battery of 6-pounders and automatic guns.

It is likely that provision will be made for six armored cruisers. Three are to be first-class ships of 12,000 tons displacement, 22 knots speed, and a cruising radius of 10,000 knots. They will be protected by a complete waterline belt of armor reaching entirely from stem to stern, and we presume protecting the broadside battery as far up as the main deck. They will each carry four 8-inch guns mounted in turrets, and a broadside battery of ten or twelve 6-inch rapid-fire weapons.

The other armored cruisers are to be of the second class, with a displacement of 6,000 tons and an armament of two 8-inch guns and ten or twelve 5-inch rapid-fire guns. The speed is to be 20 knots and the cruising radius about 12,000 knots.

The board will probably recommend the building of six protected cruisers of 2,500 tons displacement and 16 knots speed. The details of these vessels have not as yet been worked out, but they are to have the large steaming radius of 13,000 knots and a powerful battery.

Not the least important recommendation will be that all these vessels, including the battleships, should be sheathed and coppered—a provision which, in connection with their great steaming radius, will render them specially suited for service in the Southern Pacific and in the tropical waters of the West Indies.

If these recommendations are formally presented and accepted, they will exactly meet the needs of the hour in providing for a fleet of vessels that are big, fast, and powerful and able to steam unaided to the utmost limits of our newly acquired possessions.

If the new ships are made as thoroughly up-to-date in armament as they are in size, speed, steaming radius, and defensive qualities, we shall possess in them vessels that are the equals, if not the superiors, of anything afloat. We shall await with some anxiety, however, the announcement of the character of the guns that it is proposed to mount on the new ships; for it is a fact that they must be supplied with weapons of vastly greater power than those at present mounted in the navy, if they are to be a match for the best warships of foreign navies. We have no doubt that the Ordnance Board has already draughted the plans for guns of greater power than the present weapons; but we hope that it will not be satisfied with a table of ballistic powers that is one whit behind that of Vickers-Maxim in England, Krupp in Germany, or Schneider-Canet in France.

In this connection we refer our readers to the discussion of the subject which will be found on page 46 of the SCIENTIFIC AMERICAN ARMY AND COAST DEFENCE number, where the tables of our own army and navy guns are compared with those of the parties just named. That our Ordnance Board is moving in this matter is shown by the fact that the patent rights for this country of the Welin breech-mechanism have been purchased from the Vickers-Maxim Company. This will reduce the weight of these parts and, directly and indirectly, increase the rapidity of fire. Drawings of this mechanism were given in the SUPPLEMENT for June 18, 1898. We do not know whether the new Maxim-Schupphaus powder will give the high ballistic results achieved by the Vickers-Maxim guns, but there is every indication from published results that it will.

How great is the room for advancement is shown by a comparison of the present navy 12-inch gun with the 12-inch Vickers-Maxim weapon, the energy of the former being 25,985 foot tons and of the latter 44,573 foot tons, the one being capable of penetrating 30·8 inches of iron at the muzzle and the Vickers wire gun being good for 45·9 inches. The respective weights of the two guns are 45·2 tons for the hooped and 50·3 tons for the wire-wound weapon.

We have not the slightest doubt of the ability of our navy to turn out a 12-inch gun equal in power to any that exists. If the ordnance experts doubt the possibility of producing a hooped gun to stand the high pressures accompanying these velocities, they have the wire-wound system with which they have fully experimented to fall back upon.

Whatever type of gun we employ, the glorious traditions of our navy demand that the weapons mounted upon the splendid ships called for in the new programme shall be equal or superior in power to the best of those carried by the ships of foreign powers.

ENGINES AND ENGINEERS OF THE "OREGON."

In our admiration of the men and material above the protective deck of our warships we are in danger of forgetting the materials and men below it; yet the unrivaled successes of the navy are as much due to stokers, wipers, and engineers as they are to gunners, quartermasters, and the officers of the line. The engine room and stokehold should share with the gun deck and conning tower the credit of such victories as that off the south coast of Cuba; for it was the unusual speed of our battleships, due to the high state of efficiency of the motive power and engine and boiler room staff, that rendered the complete destruction of Cervera's flying squadron possible.

The 14,700 mile voyage of the "Oregon" from the Pacific stands out as the most notable engineering performance of the era of steam navies, and in its way it ranks with any of the brilliant exploits of the war. Among the mass of literature that has already been published on the subject, we have seen nothing of greater interest than a letter written by First Assistant Engineer C. N. Offley, of the "Oregon," to friends, and

published, by permission, in The New York Sun. The letter, which is of considerable length and detail, will be found in the current issue of the SUPPLEMENT, and we must be content to give in these columns one or two of the leading facts from this most interesting "log."

In the first place, the "Oregon," it seems, though rated as a vessel of a little over 10,000 tons, actually displaces about 12,000 tons with full stores and 1,500 tons of coal on board. The run of 4,076·5 knots from San Francisco to Callao was made on 900 tons of coal at a speed of 11·49 knots, or at the rate of 4·24 knots per ton. The highest speed was 14·55 knots for the 132 miles from Port Tamar to Sandy Point, when the ship burned 1 ton of coal for every 2 knots. This was done under "semi-forced draught," and the speed rose to within 0·45 knot of her contract speed. Although the ship carries four double-ended boilers, only three were in use at one time—the fourth being used whenever leaky tubes demanded repairs in any of the other boilers.

Mr. Offley attributes the success of the motive power to the excellent work put into the engines and boilers by the builders and to the great care which was taken to always "keep everything as nearly up to perfection as possible," every wear or failure, however small, being at once detected and set right.

FREDERIC WARD PUTNAM.

BY MARCUS BENJAMIN, PH.D.

This week the American Association for the Advancement of Science celebrates the fiftieth anniversary of its existence. In 1847 the American Association of Geologists and Naturalists, which had been formed in 1840 as the Association of American Geologists, met for its annual meeting in Boston. It was then determined to enlarge its scope and broaden its work. This it accomplished chiefly by the adoption of a new constitution which provided for the admission of all lovers of science to membership and the acceptance of the larger name. Accordingly, the first meeting of the American Association for the Advancement of Science was held in Boston, although it was not until 1848, a year later, that the first regular meeting of the newly formed organization was held in Philadelphia under the presidency of William C. Redfield, an early leader in American meteorology.

Regular annual gatherings of this, the fifth oldest scientific society in the United States, have since been held, except in the years 1861 to 1866, the period of the civil war. In 1866 the Association met in Buffalo under the presidency of the learned Frederick A. P. Barnard, who, for a quarter of a century, presided with conspicuous ability over Columbia University in New York city.

This year the Association turns to the place of its birth and meets in the hospitable precincts of Boston. The selection of a suitable candidate to preside over the deliberations of this semi-centennial meeting was not a difficult one. An officer—indeed, the executive officer —of the Association, after a faithful service of a quarter of a century, resigned his place at the Detroit meeting last year.

Of New England ancestry, an alumnus and a member of the faculty of Harvard University, Prof. Putnam was at once recognized as the only candidate possible, and he was, without dissenting voice, promoted from the most active office to the most honorable one in the gift of the Association. Equally was American science honored by this selection, for whether as a naturalist or as an anthropologist, Prof. Putnam is recognized as easily one of the foremost of American scientists.

Frederic Ward Putnam was born in Salem, Massachusetts, on April 19, 1839, and is a direct descendant of John Putnam, who was one of the first settlers in Salem. If we cross the ocean, the Putnam line may be traced to Puttenham of Puttenham, who died in 1642. His ancestry likewise includes the Appleton, the Ward, and the Fiske families, all well known New England names.

As a boy, young Putnam showed unusual fondness for the study of natural history, and his parents afforded him every facility in the pursuit of this favorite subject. One of the results of his fondness for the study of nature was the preparation by him of an accurate "Catalogue of the Birds of Essex County, Massachusetts," which was published by the Essex Institute in 1856, when he was only sixteen years of age, and which resulted in his being made Curator in Ornithology in that institution.

It was about this time that the attention of Louis Agassiz was attracted by the young man's devotion to natural history, and he was thus drawn to Cambridge, where, in 1856, he entered the Lawrence Scientific School of Harvard University and became one of that brilliant band of young men among whom were the younger Agassiz, Morse, Packard, Scudder, Shaler, and Verrill, all of whom now hold high rank among living naturalists in this country.

It was Putnam's intention to take a course in the Medical School, but the influence of Agassiz proved irresistible, and he soon became assistant in charge of the collection of fishes in the Museum of Comparative Zoology, which office he retained until 1864.

He then returned to Salem, where he accepted the place of director of the museum of the Essex Institute, and in 1867 he was made superintendent of the East Indian Marine Society's Museum. A few years later, largely as a result of his influence, the Peabody Academy of Science was organized by the combining of these two collections, and he was made director of the new institution.

When a student, his attention had been directed to American archæology, and in 1857, while in Montreal, Putnam discovered a shell heap, which, on investigation, he determined to be refuse material from an ancient habitation-site, and thus he became one of the first to attribute such shell-heaps to ancient man.

Although the first years of his scientific career were occupied with zoological investigations, still, on the death of Jeffries Wyman, in 1874, he was called to the charge of the collections in the Peabody Museum of American Archæology and Ethnology, in Cambridge, of which institution, in 1875, he was made curator.

His life work has since been devoted to the newer field of anthropology, but the change was not an abrupt one, and in 1876 he resumed his charge of the department of fishes in the Museum of Comparative Zoology. Thereafter, until 1878, he divided his time between the two museums, and then he decided to devote his chief attention to the growing demands of anthropology. The wisdom of this course has since been abundantly proved by his rich contributions to American archæology, and received its most conspicuous recognition in 1886, when he was called by Harvard University to fill the new chair of American archæology and ethnology, which he still holds.

PROF. F. W. PUTNAM.

In February, 1891, he was made chief of the Department of Ethnology in the World's Columbian Exposition, and in that capacity he directed the researches of seventy-five assistants in archæological, ethnological, and somatological investigations in all parts of America. The results were exhibited in the Anthropological building and afterward formed the nucleus of the anthropological department of the Field Columbian Museum in Chicago. Indeed, Prof. Putnam was the first to call attention to the importance of establishing a scientific museum in Chicago as a result of the World's Fair, and his article in The Chicago Tribune, in May, 1890, was the first public appeal to the wealthy citizens of Chicago, to secure such a museum for that city.

Prof. Putnam was called in April, 1894, to the curatorship of the department of anthropology in the American Museum of Natural History, in New York city, and since then he has had the direction of the various expeditions that have been sent out under the auspices of that institution for the purpose of forming an anthropological collection worthy of that great museum.

Brief mention must be made of other duties with which he has been active. In 1874 he was a member of the Kentucky Geological Survey, and made a special investigation of the caves of that State, and during the summer of the same year he was an instructor in the Penikese School of Natural History. He was appointed in 1876 to take charge of and report upon the anthropological material collected by the Geological Survey west of the one hundredth meridian, and three years later his results were published as Volume vii. (Archæology) in the quarto series of the reports of that survey. From 1882 till 1889 he was State commissioner, in Massachusetts, of inland fisheries.

In connection with his zoölogical and anthropological work, he has published over three hundred papers. He was the originator and editor of the Naturalist's Directory, as published by the Essex Institute in 1865. He was one of the founders of The American Naturalist in 1867 and an editor until 1874. He edited the Proceedings of the Essex Institute and the Reports of the Peabody Academy from 1864 till 1874, as well as the annual volume of the Proceedings of the American Association for the Advancement of Science since 1872; he has also prepared the annual reports of the Peabody Museum, in Cambridge, and edited all its publications since 1873. In 1890 he contributed to The Century Magazine several articles on his explorations of the famous Serpent Mound in Adams County, O., together with a summary of the archæology of the Ohio Valley, and the preservation of this prehistoric monument by the State of Ohio is due to his influence in creating a public sentiment in favor of such an action.

The degree of A.M. was conferred on him by Williams College, in 1868, and that of D.Sc. by the University of Pennsylvania, in 1874. The French government gave him the Cross of the Legion of Honor, in 1896. He has been elected to membership in fifty-six learned societies in this country and eleven abroad. In 1859 he was elected Curator of Ichthyology in the Museum of the Boston Society of Natural History, of which society he was made vice president in 1880, holding that office till 1887, when he was chosen president. Since 1890 he has been president of the Boston branch of the American Folk Lore Society, and in 1891 he was elected president of the American Folk Lore Society, the parent body. The American Philosophical Society of Philadelphia, the American Academy of Arts and Sciences, and the National Academy of Sciences, the three scientific societies in the United States to which election is only by invitation, include his name on their rolls of membership.

Prof. Putnam joined the American Association for the Advancement of Science at its tenth meeting, held in Montreal, in 1857, and in 1873 he was chosen permanent secretary, which office, by successive re-elections, he has since held. The membership, when he became secretary, was barely 500, and it is now upward of 2,000. The growth and development of the American Association are chiefly due to his tact, untiring energy, and remarkable executive ability.

His elevation to the presidency is an expression of the appreciation and gratitude of the thousands of scientific men both in this country and abroad, with whom he has formed pleasant acquaintance during his faithful service to the American Association, all of whom sincerely hope that, as a permanent member of the council, he may for many years continue to honor its deliberations with the wisdom that has come from his long service and experience.

THE NEW SMOKELESS POWDER FOR ARMY AND NAVY.

The general public has learned in a practical way during the war the great superiority of smokeless powder over the now obsolete brown powder. The interference of our own smoke with our guns at San Juan and Santiago, and the way in which the Springfields, with which the volunteers were armed, drew the Spanish fire were object lessons easily understood and laid to heart by a practical people.

The decision of both the Army and Navy Departments to make the new powder the standard type in both branches of the service will be received with unfeigned satisfaction, as will the announcement that large orders are being placed for its manufacture. One of the chief causes of our backwardness in this matter has been the fact that, for lack of encouragement, manufacturers have hesitated to enter extensively into the manufacture and do the necessary but costly experimental work. Now, however, they not only start with large orders for an excellent powder, but the experience they will gain must necessarily result in a steady improvement in the art as carried out in this country.

In the current number of the SCIENTIFIC AMERICAN SUPPLEMENT will be found a lengthy account of the

new smokeless powder. It is known as the Maxim-Schupphaus. It is a purely American powder, and in its present perfected form it represents the results of experiments which have been carried on steadily for the past four years. In 1893 the inventors were collaborating in the attempt to find a suitable propellant for firing large masses of high explosives from rifled guns, the object of their search being a powder which would give a less sudden initial acceleration to the projectile, with a more uniformly sustained subsequent acceleration in the gun than was possible with the then known powders. Realizing that the chief trouble with the existing smokeless powders was the serious erosion of the bore due to the high pressure and temperature of the gases, they determined to use guncotton, which gives low erosive effects, and to use such a form of grain that the surface at first exposed to the flame of ignition would be relatively small and then increase rapidly as the projectile traveled up the bore.

The theory worked out excellent results on the proving ground, as may be judged from the fact that a 35-pound projectile has been fired from a 4·7-inch gun with a velocity of 2,913 feet a second on a maximum pressure of only 35,000 pounds per square inch. Our new powder is not only free from erosive effects, but it has been proved to be thoroughly stable.

A NEW SAMPLING MACHINE.

The accompanying engraving represents an improved sampling machine which is arranged to utilize the pulp or other material as the motive power for setting the apparatus in motion.

The machine is provided with a fixed casing having an outlet for the discharge of the bulk of the material from which the sample has been taken. From the bottom of the casing a post rises upon which a cone-shaped wheel is mounted to rotate. This cone-shaped wheel has spiral ribs terminating in the apex of the

BYRNES' SAMPLING MACHINE.

cone, so that the material or liquid to be sampled and discharged upon the apex through a hopper, is equally divided by these ribs and flows down the sides of the cone in equal quantities between adjacent ribs. One of the chambers formed between two adjacent ribs terminates at its lower end in a sample chute formed with a downwardly-extending spout. A portion of the pulp or other material can thus be discharged into a sample receiver held in the wall of the casing, thence to be conducted to a receptacle outside of the casing. When the material passes down into the spiral chambers, it is evident that a rotary motion will be imparted to the cone-shaped wheel. The material is therefore discharged mostly into the casing, only a small portion being dropped into the sample receiver at each full revolution of the wheel. Any desired quantity can be taken as a sample of the entire bulk, the proportion being regulated by the make of the machine, the number of chambers, the diameter of the wheel, and the opening of the receiver. The apparatus has been patented by the inventor, Mr. Owen Byrnes, of Granite Butte, via Gould, Mont.

Important Experiments in Aerial Navigation.

The Engineer reports that, on July 27, a series of experiments in aerial research were conducted in the grounds of Shaw House, near Newbury. The experiments were carried out under the direction of the Rev. J. M. Bacon, Dr. R. Lachlan, Mr. J. N. Maskelyne, and others, with the advice and assistance of Lord Kelvin, Lord Rayleigh, and other men of science. The balloon was in charge of Mr. Percival Spencer and his brother, and was filled with 40,000 cubic feet of gas. The main object of the experiments was to discover in what measure the intensity of sound is influenced by altitude, by the presence of clouds, etc. The weather proved favorable for the observations, and the ascent was successfully made at twenty minutes past five o'clock, the balloon drifting steadily in a northwesterly direction. As soon as the balloon had had a fair start the series of experiments commenced. The first experiment in acoustics was with the voice, followed by five tests with musical instruments, these being succeeded by the discharge of rifles and blasts of the siren from an engine. Then came a rifle volley, followed by a roll of musketry, succeeded in turn by discharges of cotton-powder, four ounces being used in each charge. After this came three further discharges of cotton-powder, with eight ounces in each charge. When the balloon had traveled a considerable distance there were two explosions of cotton-powder with double charges, the final experiment being a comparison between a discharge of four ounces of gunpowder and four ounces of cotton powder. The aeronauts had with them a receiving instrument, and by noting the altitude and the sounds which reached them, took the angular distance. The balloon descended at ten minutes to seven o'clock at North Denford. All the experiments proved highly successful.

A New Pompeii.

This title is perhaps an exaggeration, but it is certain that if the published reports are true, the German archæologists who are excavating on the site of ancient Priene have made a discovery of the highest interest. It is well known that Priene is in Asia Minor, and that the modern city of Samsoun occupies its ancient site. Several years ago an English expedition unearthed and studied the temple of Minerva, the chief sanctuary of the city, built by order of Alexander; but its ruins, although interesting, were abandoned, and they have since been despoiled by the inhabitants of the neighborhood. In 1895 the Germans resumed the exploration of the region in behalf of the Berlin Museum, at the expense of the Prussian government and under the direction of a young architect, Wilhelm Wilberg. The work of excavation is already sufficiently advanced to enable us to judge of its rare importance; a whole city is being unearthed, in almost as good preservation as Pompeii. And this is the more important because up to the present no similar discovery has ever been made that gives precise indications of the general arrangement of a Greek city, of its public monuments, or its individual dwellings. The city thus exhumed is assuredly of the period of greatest Greek beauty; the streets cross at right angles and are laid out with the greatest regularity, and we can identify colonnades, theaters, market-places, shops, and houses with their decorations and interior arrangement. South of the temple of Minerva has been found the agora, surrounded with great colonnades, while opening on one of its corners is a small square edifice somewhat resembling a theater and constituting perhaps the place of meeting of the city council. It is in admirable preservation, and sixteen rows of seats can be seen still in place. Worthy of note is a vault in one of the walls—a thing extraordinarily rare in Greek architecture. We should add, in closing, that among the structures that have been entirely exhumed is a theater whose scene is intact, which will doubtless solve some of the problems connected with this special part of the Greek theaters.—Literary Digest.

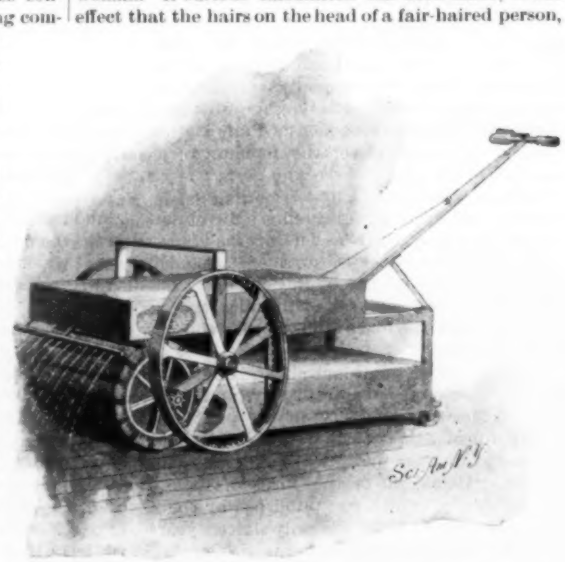
A SCRUBBING MACHINE.

To provide a machine for scrubbing floors, so constructed that it will sprinkle water or a washing compound on the floor, take up the water, dry the floor, and deliver the material taken up into a receptacle forming part of the apparatus, Mrs. Hattie E. Lane, of Colfax, Ind., has invented the machine forming the subject of the accompanying illustration.

The apparatus is provided with a frame, in which wheels are journaled. In front of the wheels a drum is mounted, consisting of alternate sections of rubber and bristles, and operated as shown in the engraving. Above the drum a receptacle is located extending forward to some distance, and containing water or some washing compound. A valve, situated in the receptacle, controls the delivery of the water, and is operated from the handle of the machine. When it is desired to open the valve, a lever on the handle is operated, thus acting on the chain or cord connected with the valve. Springs automatically close the valve when the pressure on the lever is relieved. A receiver is suspended from the rear portion of the frame, and has its concave forward end in contact with the floor and with the drum.

In operation, the valve being open, the machine is pushed along, whereupon water will be delivered to the floor in front of the cleaning drum. The floor will be scrubbed by the brushes on the drum, and will be dried by the rubber strips. The material taken up by the scrubbing drum will be delivered into the receiver suspended in the lower portion of the frame.

This device, it is claimed, will clean a floor as readily and as perfectly as a brush operated by hand.

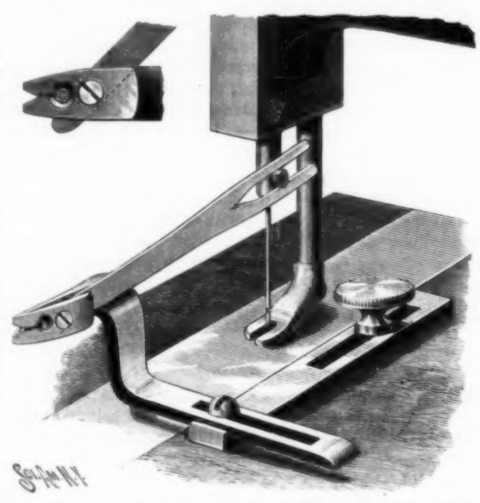


A NOVEL MACHINE FOR SCRUBBING FLOORS.

AN IMPROVED SEAM-RIPPER.

In an invention recently patented by Lemuel Merrill, of 52 Federal Street, Boston, Mass., a novel device is provided for ripping seams which is so constructed as to cause a reciprocating knife held between the members of a body-section to cut the threads of a seam at both up and down movements.

In the attachment illustrated, a shield-like device is provided which is formed to receive the seam and which co-acts with the reciprocating ripper-arm. The shield



SEAM-RIPPER ATTACHED TO A SEWING MACHINE.

forms part of an attachment adapted to be adjustably secured to the sewing machine, and is provided at its front end with a tapered slot terminating in a circular opening. This circular aperture enables the cut threads to leave the shield readily. The ripper-arm is pivoted to the shield and at its forward end is sharpened to a rounded cutting edge. By its reciprocating movement across the slot of the shield, the arm is enabled to cut both at its up and down movements. As shown in the illustration, the arm may be operated by the needle-bar of the machine, the forked rear end of the arm engaging the bar for that purpose.

In practice the invention is also embodied in a hand ripping device, formed after the manner of scissors.

When used in connection with a machine, both hands are free to guide the work. While the threads of a seam may be readily cut by the knife-edge, there is, nevertheless, no danger of cutting the material, since the knife-edge is protected by the shield.

Human Hair.

It is a curious fact that red-haired people are far less apt to become bald than those whose hirsute covering is of another hue. The average crop on the head of the red-haired person is said to be only about 30,000 hairs. Ordinary dark hair is far finer, and over three dark hairs take up the space of one red one; 105,000 are about the average. But fair-haired people are still better off; 140,000 to 160,000 are quite a common number of hairs on the scalp of a fair-haired man or woman. A curious calculation has been made, to the effect that the hairs on the head of a fair-haired person, if they could be plaited together, would sustain a weight of something like eighty tons, equaling that of five hundred people.—Medical Record.

ITALY is the first of the powers to learn a lesson from the war. The Navy Department has given orders that wood shall not be used on battleships.

Typewriter's Cramp.

Sufferers from writer's cramp are, in the majority of cases, quite able to produce manuscript by means of a typewriting machine, but an instance in which this resource failed is recorded by Dr. F. Hampson Simpson in a recent number of The Birmingham Medical Review. He states that he is not acquainted with any authentic record of a similar case, although he has recently met with two examples of what was called typewriter's cramp; one of these patients, however, seemed to suffer from neuritis and the other from pain and fatigue in the right hand unaccompanied by muscular weakness or spasm. The patient whose symptoms Dr. Simpson describes is at present a muscular man, thirty-three years of age. He became a clerk when eighteen years old, and then wrote with a pen on an average from seven to eight hours daily. In March, 1889—that is, after about seven years of this employment—the initial symptoms of writer's cramp declared themselves, and at the end of three months all the fingers of the right hand were invaded by spasm, which seriously interfered with writing. In 1889 he learned to use the typewriter machine, and in 1890 he commenced learning to play the harp, but after a few months he found that playing brought on cramp, affecting the right hand generally, more especially the first and second fingers, so that he gave up the harp at the end of 1890. For three years (1893-94-95) he was at sea as interpreter on board a transatlantic steamer. In January, 1897, he entered an office as typewriter, but was only engaged in working the machine from two to three hours daily. Toward the close of one of the days at the end of February, while at work "typing," his right index finger became bent by cramp. From this time on, a repetition of the cramp occurred toward the evening of each day, a slight involuntary flexion at the wrist being superadded, and in less than a month the exaggeration of the spasm led him to substitute the middle for the index finger; six or seven days later this middle finger also became the seat of similar spasm. Dr. Simpson observed very little tendency to spasm in the operating finger of the right hand during the early portion of the day's work, but after about two or three hours typing the index finger of the right hand (and the middle finger since its substitution) became very fatigued, and to the flexion of the finger and wrist incidental to striking the keys there was superadded a spasmodic contraction which overflexed those parts. This did not appear, however, to seriously impair the precision of his touch, and an inspection of his type-written work revealed no objective evidence of the spasm in the right finger. It was suggested that he should strike the keys with a little hammer or percussor, and he employed this with much benefit and relief for some little time, but the cramp now affects the whole forearm, and he intends to abandon his present occupation for another of a totally different description. He has been a pianist for many years, and his piano-playing is not in the least interfered with by any digital spasm; his technique and execution are above the average, and his prestissimo passages are perfect.

The Chemistry of Gout.

The results of an investigation recently carried out by Dr. A. P. Luff, as to the value of certain drugs in the treatment of gout, throw considerable doubt upon the views held concerning the efficacy of alkalies as remedial agents in that disease, so far as regards the removal of uric acid from the system by their solvent action. From Dr. Luff's experiments it appears that neither potassium nor sodium bicarbonates, lithium carbonate, potassium or lithium citrates, or sodium phosphate, exercise the slightest influence in delaying the conversion of quadriurate into biurate. A similar conclusion was drawn from experiments with salicylates, piperazine, and lysidine. None of these substances was found to increase the solvent power of the blood for sodium biurate, and hence it is inferred that their administration to gouty subjects with the object of removing uratic deposits in the joints and tissues appears to be useless.—Pharmaceutical Journal.

Fig. 1.—DECK VIEW OF THE "BRANCKER," SHOWING THE TANKS AND THE HYDRAULIC HOISTS FOR TANK CYLINDERS.

THE GREAT SEA-GOING DREDGES ON THE MERSEY BAR, LIVERPOOL.

An examination into the local tidal conditions at Liverpool shows that the estuary of the river Mersey and the channel in front of Liverpool are very much like a bottle, with the large part above Liverpool and the neck right at the city, and then an expanding, flaring mouth out to sea. The tides, which are at "springs" 31 feet high, rush twice each twenty-four hours through the neck and up into the great bottle and out of it again. The current acts with tremendous force as it rushes in and out, scouring a channel in front of Liverpool 60 feet deep through the narrow, contracted neck of the bottle. But up in the bottle it spreads out and moves about here and there great masses of sand, shifting its channel of flow from time to time, and generally conducting itself in the most independent and erratic manner. When it rushes out at ebb, or falling, tide, trying to empty the bottle as quickly as possible, it scours its way to sea through the sands which the ocean waves have drifted in. Such was the force of the outgoing current that it was able to maintain a channel through the sea bar eleven miles from the shore line with 10 feet of water in it at low tide at the shoalest point, or 42 feet at high tide.

Here occurs a very interesting episode in which one of our own engineers played an important part. In 1883, the Manchester Ship Canal project had assumed definite shape and had been presented to Parliament, which alone has the power in Great Britain to authorize the building of railroads, canals, or other commercial works. Manchester is about thirty-five miles from the deep water in the estuary, and lies on one of the small rivers, the Irwell, that empties into the Mersey. The plan proposed to Parliament was to come down with the canal from Manchester to Runcorn, on the estuary, and from that point to build training walls and to dredge a channel out into the estuary for several miles until deep water was reached. Liverpool, which looked with disfavor upon the canal project, since it would, if carried out, cause loaded vessels to pass by it going up the canal to Manchester instead of unloading goods at Liverpool, opposed the project before the Parliamentary committees.

The Mersey Dock and Harbor Board of Liverpool employed Capt. James B. Eads, the distinguished American engineer, to investigate the effect of building the canal into the estuary of the Mersey. Capt. Eads studied, compared, and worked out the hydraulic conditions, and presented to the Committee of Lords, which had the subject in hand, a clear, graphical exhibition of the great and potent causes that maintained a channel of 10 feet at low water on the Liverpool bar. He proved that this depth was entirely due to, and was essentially dependent upon, the reservoir capacity of the estuary; that to reduce this would reduce the depth on the bar; that in every average tide, twice each twenty-four hours, 500,000,000 cubic yards of water passed into and out of the estuary; that every yard of this water was needed to maintain the depth eleven miles out in the ocean; and that, consequently, the building of the walls of the canal several miles into the Mersey would occupy the tidal area and injuriously affect the depth of water on the sea bar. He convinced the committee, but they asked him how he would himself build the canal if he had it to

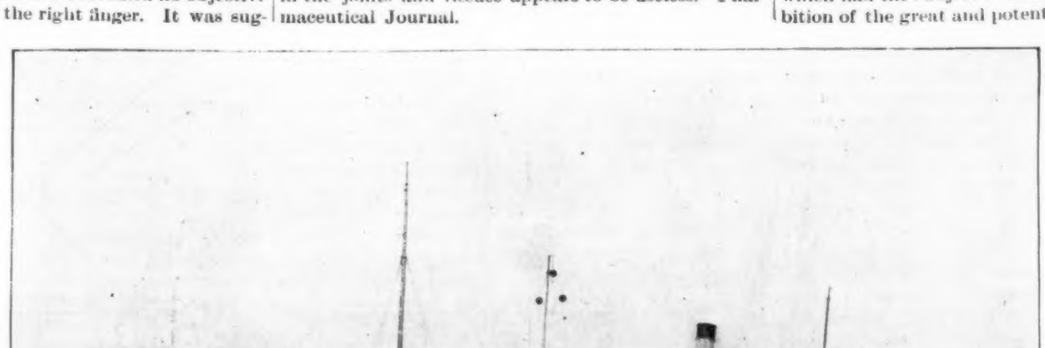


Fig. 2.—THE SEA-GOING DREDGE "BRANCKER" AT WORK ON THE MERSEY BAR, LIVERPOOL.

Length, 320 feet; beam, 47 feet; depth, 20½ feet. Capacity, 2,700 tons per hour.

do. He replied that he would carry it along the banks to Eastham, several miles beyond Runcorn, where he would find deep water near the shore. Whereupon, at the next session, a new proposition came before Parliament from Manchester, embodying this suggestion of Capt. Eads. The bill went through, and the great canal has since been built.

Careful velocity observations show that eleven miles out to sea on the bar, this great body of tidal water, issuing from the estuary, maintains a velocity at ebb tide of from two and a half to three miles per hour. The magnitude of the forces employed by Nature to maintain the channel there will be appreciated if we consider what 500,000,000 cubic yards of water amounts to. This body of water would fill the trunk of a fair-sized ship canal between New York and Chicago, a thousand miles long. It would fill a reservoir such as that in Central Park, in New York, 400 feet deep.

It was necessary, however, to increase this depth of 10 feet at low water to 26 feet; but so far out in the sea was this channel that training works to concentrate the tidal flow were out of the question on account of the enormous expense; just as they would have been at the sea channels out of New York Harbor, down by Sandy Hook. The necessity for a channel that would admit at once on arrival the vessels of the deepest draught, like the "Campania," grew greater and greater. The United States had gone to work with hydraulic dredges to make a channel 30 feet deep out of New York at all stages of the tide, and had accomplished it. The Suez Canal was being enlarged and its depth increased to 28 feet, and it had been decided by the International Commission to deepen it to 30 feet. Southampton had unexpectedly come forward as a competing port with Liverpool, and the American line of steamers had gone there, as 30 feet of water at low tide had been obtained. Other great ports of the world were working for 30 feet, and Liverpool must have it, and the old and inconvenient method of transferring transatlantic passengers upon a lighter fifteen miles out from the landing stage at Liverpool could no longer be tolerated.

After some experiments with a small plant had shown satisfactory results, the subject was attacked vigorously and the decision reached that a mammoth hydraulic or suction dredge beyond anything that had been attempted would be necessary to make and maintain a channel under such extraordinarily difficult conditions: a great seagoing monster that could work effectively in almost any weather or seaway. Thus the great dredge came into existence to overcome the obstacle to the prompt dispatch of business. The dredge is herculean in size and work. The accumulations of the Augean stables, cleaned out by Hercules with his hydraulic flushing, would have lasted about two minutes if this dredge had been there, and had a fair chance at it. It is as big as an ocean steamer: a steel hull 320 feet long, 47 feet wide, and 20½ feet deep, with a loaded draught of 16 feet. It is a veritable machine shop for doing this work. Its output is immense. It sucks the water and sand up through a pipe that a good sized boy could walk through, nearly 4 feet in diameter and 76 feet long, so as to dredge in 53 feet of water. It discharges the material into eight tight pockets or hoppers in its own hull. They hold altogether 3,000 tons, and the solid mass of sand which the dredge can pump up from a depth of over 50 feet is equal to 2,000 cubic yards lifted in three-quarters of an hour. In one day it has raised from the bar, dumped into itself, carried 4 miles out to sea and let go in water many fathoms deep, a mass of sand which, if built into a monument 30 feet square at the bottom and 15 at the top, would rise into the air to a height of 415 feet, nearly twice the height of Bunker Hill Monument and well up toward the top of the Washington Monument. There has been removed and carried out to sea by this and companion dredges 27,287,110 tons to date, equal to 17,000,000 cubic yards of solid earth; a mile square of dirt 25 feet high. It would fill a street nine miles long like lower Broadway between the building lines and as deep as the highest of the "sky scrapers."

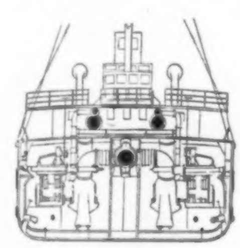


Fig. 3.—SECTION SHOWING THE CENTRIFUGAL PUMPS.

The channel which has thus been made and maintained is 1,500 feet wide and over 26 feet deep at low tide, or 57 feet deep at high tide. Neither "Campania" nor any other ship has now to wait a moment, and you can get aboard of the Cunard and White Star line steamers at the New York dock and be landed without any detention at a landing stage in Liverpool; and the cars that come alongside of it will take you to London at the rate of 60 miles an hour.

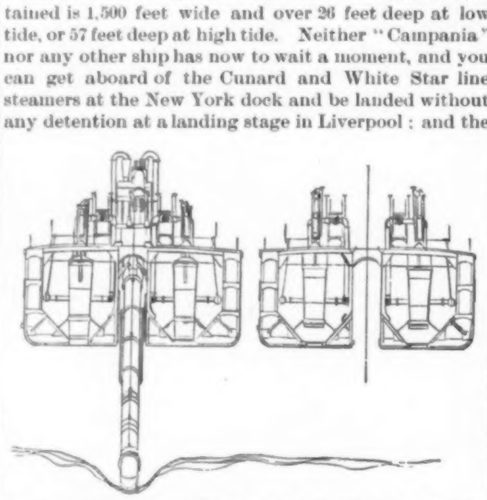


Fig. 4.—SECTIONS THROUGH THE "BRANCKER," SHOWING THE TANKS IN THE LOADING AND UNLOADING POSITIONS.

Some details of the methods of working these mammoth tools—for there are two of them now—will be of interest and serve to explain the illustrations.

The pumping machinery comprises, first, two centrifugal pumps, each 6 feet in diameter, which run at 150 revolutions per minute. From each of these leads a 36-inch circular steel suction pipe, which unites with a main suction pipe, 45 inches in diameter, which is so hung on a trunnion by a ball and socket joint that, even in a seaway, when the waves are running ten feet high, the great dredger keeps steadily at work. The suction pipe has been broken but twice in several years' work. The water and sand are discharged into eight tanks built in the hull of the boat. When they are full, the pumps still keep at work, since some of the material pumped up is water; but this is allowed to run overboard through overflow sluices, as shown in the illustration of the boat at work. When the whole mass in the tanks has thus become solid sand, the pipe is raised and the anchors also, and the load is taken to sea and dumped in deep water.

This dumping is done in a very ingenious manner, by a method designed by Mr. Lyster, the engineer of the Liverpool docks. In the bottom of each tank is a circular opening, 4 feet in diameter. A circular tube of the same size fits down on the edge of the aperture, thus preventing the escape of the sand through the opening while pumping. To discharge the load from the eight tanks, these tubes or cylinders are all lifted a short distance by hydraulic power, and the sand runs out of the bottoms of the tanks. To facilitate its exits, jets of water are thrown into the mass of sand from the cylinder and from the sides of the tank. The whole load of 3,000 tons is dropped into the ocean in the space of five minutes.

The following disjointed facts will answer questions that will naturally arise in the mind of the reader. The sand weighs about 124 pounds per cubic foot. Sixty per cent of the mass pumped up, as it comes through the pipe, is solid material. The pumping engines are each of 750 horse power. There are 41 employes on board, working 24 hours in shifts. It costs, to pump the sand, carry it to sea four miles, discharge it and return to the dredging cut, 1½ cents per ton, or 2½ cents per cubic yard, not counting interest on plant or depreciation, but everything else. The length of channel that has to be dredged is 1¾ miles. The dredge at work does not move forward or backward, but swings on anchors placed ahead and abreast, by means of several steam capstans and winches, her two rudders, and the two screws, thus swinging back and forth over the arc of a great circle—a giant mower, cutting a swath through this ocean bar to make a path for commerce. The full navigable depth dredged, 26 feet at low water and 1,500 feet wide, with a central sounded depth of 27 feet, was maintained by the estuary tidal currents without any dredging from December 7, 1896, to May 25, 1897. There are two dredgers at present, the "Brancker" and the "G. B. Crow," the latter recently built and with some minor changes—the suction pipe being longer than that of the "Brancker," so as to dredge in somewhat deeper water, 53 feet, as against 47 feet of the "Brancker." The cost of each of these dredgers was about $180,000.

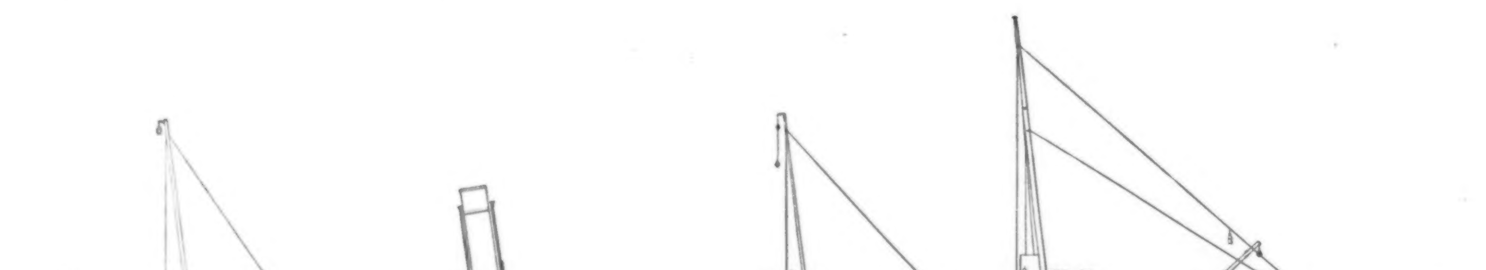


Fig. 5.—LONGITUDINAL SECTION THROUGH THE SEA-GOING DREDGE "BRANCKER."

West India Weather Service.

The West India Weather Service was practically commenced August 10, when the Washington office received reports from six of the ten observation stations recently established there. Prof. Willis L. Moore said the system was now in complete working order. The department will be enabled to forecast the terrible West Indian hurricanes that for years have swept the Atlantic coast without warning. The whole group of islands has been plotted, and meteorological conditions are charted daily at the recently established stations. It was feared that the West Indian service might be hampered by delays in the cablegrams, but Prof. Moore stated that the reports reached the Washington office within an hour and a half after the observations were made.

IN advocating the practice of boiling all water (and milk) of uncertain purity, Prof. Bizzozero combats the prejudice against boiled water as a beverage. He maintains that the "taste" frequently complained of in boiled water is really caused by the kettle, and can scarcely be due to the absence of CO_2 or dissolved air, of which water from wells of great depth often contains very little.—Practitioner, lxi., 63.

The American Association for the Advancement of Science.

THE JUBILEE MEETING AT BOSTON.

We have given preliminary announcements of the jubilee meeting of savants in Boston, from August 22 to 29. It will be of value now to mention a few especially interesting papers of which our correspondent obtained notes in advance, to be followed in our next number with more full reports of the proceedings.

Contemporaneously with the birth of the A. A. A. S., that is to say, about half a century ago, certain radical views began to be promulgated that have since revolutionized scientific thought. The cell doctrine was suggested in 1839, and about that time was worked out the law of the correlation and conservation of forces. Darwin's theory as to the origin of species, Huxley's idea that protoplasm forms the physical basis of life, and Spencer's argument for the unity of nature date from about that epoch. It is only since 1843 that the sciences of embryology and morphology have been placed on a firm basis.

Hence much interest was awakened by the opening address of Vice-President A. S. Packard, of Brown University, before the section of zoology, on "A Half-Century of Evolution." He said, in substance, that the two leading problems confronting zoologists are: "What is life?" and "How did living beings originate?" Coming centuries may, perhaps, solve the first, but a solution of the second has been generally accepted. The theory of evolution is the one indispensable instrument on which the biologist must rely. In one sense this theory has been in the air ever since the days of the Greek philosophers, yet the modern views as to the struggle for existence, the preservation of favored forms, by variation, adaptation, and selection, result from the labors of investigators like Darwin, Haeckel, Wallace, Spencer, Huxley, Hooker, Gray, and many other recent workers, who have established it on a firm basis and made it a useful tool for every department of scientific research. The nebular hypothesis teaches that the same process observed on our own planet has applied to other members of the solar system, and probably to the universe. Although opposed by many, the immediate effects of the acceptance of this theory have been most happy.

Collectors, instead of narrowly gathering one or two specimens for their cabinets and being content therewith, have looked at the environment and distribution of what they have gathered, and philosophically considered the relations of present forms to past geographical changes. Light, heat, cold, gravity, the atmosphere, electricity, and geological laws have been studied to explain the extinction or renewal of plants and animals.

Dr. Packard passed in review the more important epochs in geological history, showing wherein different classes of beings arose, and particularly noting the result of the uplifting of the great Appalachian chain, at the close of the Paleozoic period, which he regarded as the most influential event in geological progress. New forms and classes are related to the opening of new areas of land, as is peculiarly illustrated by the age of reptiles. During that age the competition amid jungle, forest, and plain became so fierce that the pterodactyls took to flight and, developing membraneous wings, lived in a medium before untried by any vertebrate. They were gigantic, but did not last, because of the change in their environment. The feebler forms succumbed to the agile, tree-climbing dinosaurs, while the birds, waxing stronger, exhausted the food supply for these colossal bats. Another class of reptiles essayed the problem of flight with better success, replaced older types, and has now become four times as numerous as the reptiles and six times outnumbers the mammals.

In a similar way the speaker reviewed the effects of other revolutions in the animal forms, showing how, as they gained in shrewdness and brain power, the line of development culminated in man. So strong is the piled up testimony geology affords to evolution that, if it should be necessary to give up this theory, it would also be necessary, in the opinion of Dr. Packard, one of the best and strongest of American naturalists, to give up the theories of gravitation, the correlation of forces, and the conception of the unity of nature. All these are interdependent, and together they form the foundation of science.

One of the most important addresses was by Dr. Charles D. Walcott, director of the United States Geological Survey, regarding the topographical work of the survey, its development, and its application to engineering problems. Nearly twenty years have passed since this bureau of the Department of the Interior was created. During this time ten million dollars have been appropriated for its work, embracing topographic and geologic surveying, investigations in hydrography, forestry, and other branches helpful to geology. About three million five hundred thousand dollars have gone for topographic maps as the basis for other surveys and investigations.

Prof. Walcott reviewed the methods that each year have led to the production of maps of higher precision and practical value. The first expeditions, sent out by the War Department early in the century, excellent for that time, left little of present utility. Between 1867 and 1879 various independent explorations were made of selected regions; e. g., the survey of the fortieth parallel, under King, the survey of the Territories under Hayden, of the Rocky Mountains under Powell, and of the region west of the one hundredth meridian under Wheeler. This work was generally by fair triangulation, the details filled in by long distance sketching. Topographic mapping passed thus from the expeditionary to the reconnaissance stage. The scale was four miles to the inch, and a contour interval was used of from 200 to 300 feet. About 360,000 square miles of territory was thus surveyed.

When, in 1879, the four independent surveys were replaced by the United States Geological Survey, the new organization inherited the methods of its predecessors. "Changes," Prof. Walcott stated, "have been made from time to time in these methods, with a view to improving the character of the work, a general adoption of traversing being especially mentioned. Originally the magnetic courses and distances were recorded and sketches made in a notebook, the results being afterward platted. The advantages of the traverse plane table soon became apparent, and its use in present methods has marked an important era. This plane table is a simplified form of that in general use." In time it became evident that the standard of the maps must be raised above that of reconnaissance surveying. The scale, which had been about two miles to the inch, was changed to one mile. Yet there is no such thing as an absolutely accurate map. The best work of the survey costs from ten dollars to fifteen dollars per square mile, for the inch scale; but from one hundred dollars to ten thousand dollars might be expended on a square mile and still leave certain requirements unsatisfied.

A step in advance was taken, only last year, by an act of Congress, authorizing the establishment of permanent bench marks, at intervals in areas under survey; being brass-capped iron posts, or copper tablets fixed in masonry, on which elevations above the sea level are stamped. This requires spirit leveling of a higher order of accuracy than heretofore. Thus, by one change after another, the work of the survey has been steadily improved, till the maps now produced equal the demands of the times. They even show the culture, drainage, and other features by colors.

The States of Connecticut, Massachusetts, Rhode Island, Delaware, and the District of Columbia and the Indian Territory have been completely mapped, while one-half the areas of Arizona, Kansas, Maryland, Utah, Virginia, and West Virginia have been surveyed. No more than 10 per cent of any other State has been surveyed. At the present rate one hundred years will be needed to complete the topographic atlas of the United States, exclusive of Alaska.

Prof. Walcott called attention to the limitations to the utility of such work. Location is rigid, but sketching relative. The minute details are not attempted. They serve the interests of the community rather than of the individual. They may not locate a ditch for a farm, but would aid in determining the irrigating system for a region. They show the catchment areas, altitude, and slope of each stream. The speaker went into detail as to the utility of these maps in certain ways. He quoted the testimonies of railroad officials and of city engineers, as to the great saving thus effected, in showing the exact drainage areas, the sources of water supply, the configuration of the surface, and the relative elevations of localities. Among the authorities thus cited was the chief engineer of the Croton Aqueduct Commission, of New York city.

Dr. B. E. Fernow, late chief of the United States Forestry Division, and now director of the newly established New York State College of Forestry, at Cornell University, addressed Section "I" on the aims of that college. Only 25 years ago, at the suggestion of the late Dr. F. B. Hough, this very section of the A. A. A. S. addressed a memorial to Congress that secured recognition for the previously unknown science of forestry; and now this movement has culminated in the creation of a College of Forestry by the Legislature of New York. This act also provided for the purchase of a demonstration area in the Adirondack Mountains in a manner to withdraw it from the baneful influence of politics. The course of study leading to the degree of Bachelor in Forestry occupies four years, two of which are devoted to physics, chemistry, geology, botany, entomology, and other necessary sciences, while the remaining two are given to professional forestry courses, ten in number. Provision is also made for popular courses.

The "demonstration area" is to consist of 30,000 acres in the Adirondack region. The motto is not the sentimental one of "Woodman, spare that tree," but the practical one of "Woodman, cut those trees judiciously." The handling of a slowly maturing crop like forest trees is unlike any other problem. Fully a century is oftentimes needed for the mature growth. Obviously it would be unwise to cut down the ripe product and then wait another century for further income. A system is needed that takes the interest in trees ready for the ax, while the great principal, the forest itself, remains practically intact. Spruce, useful for pulp, might be substituted for some of the less valuable hard woods, and be permitted to grow only to the best condition for pulp. The school forest, in addition to silviculture, teaches as to reforesting denuded areas, methods of transportation, road building, and the improvement of watercourses.

Prof. Emerson, of Amherst College, presented an outline map of Southern New England. His work has included the complex districts of central and western Massachusetts, over which he has tramped in every direction, and he is an authority on the geology of the Connecticut Valley. His map covers Massachusetts, Connecticut, and Rhode Island. It shows, first, the line of Archean outcropping rocks which extends along the axis of the Green Mountains, from the Hoosac Tunnel to the Highlands on the Hudson; and, secondly, the eastern Archean granite area from Southboro to New London. The order of the successive formations was noted, as well as the distribution of feldspathic material toward the northeast and the eruptions that furnished softened matter to blend with it. He also spoke of the disposition of the great beds of sandstones and shales, their folding and compression into gneiss and marble. He explained the later processes by which the present topography was produced, the whole forming a paper of much interest to the geologists assembled in Section "E."

An illustrated address was given by Dr. H. C. Hovey, before the geological section, concerning the "Region of the Causses." The causses are lofty tablelands in southern France, along the declivity of the Cevennes Mountains, and the term comes from the Latin "calx," meaning limestone. Dr. Hovey was one of a party of explorers led by Mr. E. A. Martel, last September, through the winding gorges of the rivers Tarn, Jonté, and Dourbie, much of the journey having to be made by canoe or on the backs of mules and through a region almost as little known to the ordinary tourist as if it were in the heart of Africa. The causses vary in height from 2,000 to 5,000 feet, and the canyons cutting through them resemble those of Arizona, both in grandeur and brilliant coloring. The cliffs are from 500 to 2,000 feet in vertical altitude, and are mostly of Jurassic dolomite, with occasional beds of shale, and topped by the Oxford limestone, retreating in gigantic steps. The rapidity of the streams was ascertained by staining the water with aniline dyes, which added to the splendid coloring of the gorges. At Pas de Soucy the Tarn is lost amid caverns, to reappear a mile below.

The walls of the canyons abound in cliff dwellings, recent and prehistoric, and many dolmens are found on the summits. The main causses are those of Sauveterre, Méjean, and Noir, although there are several smaller ones. They are the remains of a vast plateau gradually lifted and meanwhile cut by canyons. Many large caverns were explored, some of them long known to the local inhabitants and others wholly new. From one of them 300 human skeletons have been taken, and from another the bones of more than 100 cave bears. Many of them are utilized as sheepfolds, and some of them are inhabited. The cave of Darjelan has 20 halls, from 65 to 600 feet long, the lowest of them being 400 feet deep. The party discovered and explored the wonderful "Aven Armand," whose total vertical depth is 680 feet. The descent into such pits is by long rope ladders, and subterranean streams are explored by portable canvas boats. Martel's methods of systematic underground exploration were explained, and reference was made to the important work being done by the "Société de Spéléologie" in all parts of Europe. Few caverns equal that of Bramabiau, swept by the river Bonheur, the measured length of the tunnel being 2,610 feet, and the dry ramifications bringing the distance up to more than four miles. Where the stream emerges it leaps down seven waterfalls, the last one being 37 feet high, under an arch nearly 300 feet in altitude. Besides explorations in caves and canyons, the party visited an extraordinary rock city called Montpellier le Vieux, formed by the erosion of the Causse Noir at the junction of the Jonté and Dourbie. It resembles the weathered rocks around Pike's Peak, and its curious pinnacles, natural fortifications, and temples cover an area of 2,000 acres. The region of the causses has many other interesting features and deserves to be made widely known.

Among other papers offered may be mentioned an interesting historical note by Mr. John Murdoch, of Boston, concerning the Rosy Gull, known to ornithologists for many years but rarely seen, not more than 110 specimens being known to exist in all the collections in the world, of which 81 were taken by the Point Barrow expedition, in 1881-2, and only 15 since. Their main breeding ground is probably on Keenan Island, north of the Pinot. They keep close to the loose edge of the main ice pack, moving south with it in winter and retiring far within the Arctic Circle in summer. It is small, with a wedge shaped tail, and is of a deep rosy color where other gulls are white. This extraordinary and beautiful Arctic bird is represented in the collection of the American Museum of Natural History in this city.

TEST OF A SIX-INCH EXPERIMENTAL KRUPP PLATE.

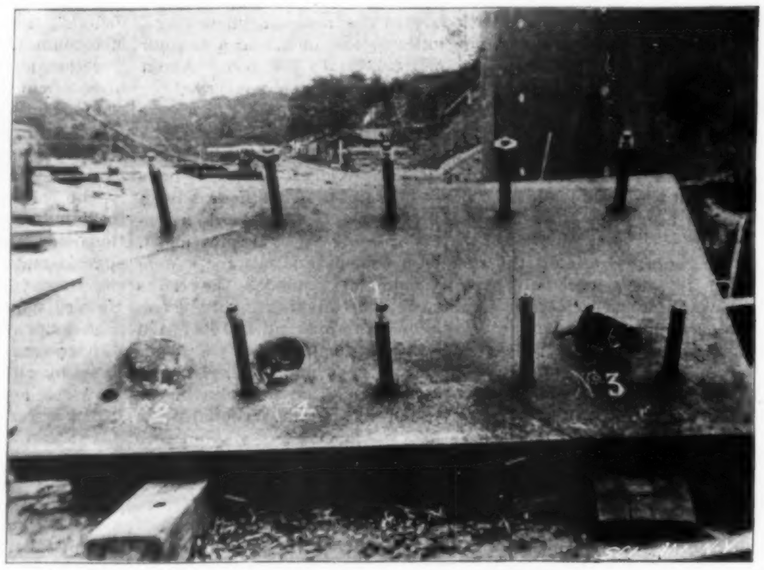
Our naval authorities are to be congratulated on their broadmindedness and enterprise in adopting a foreign process of armor-plate manufacture which has easily proved itself to be the very best in the world. The Krupp gas process has produced plates which are as superior to the Harvey and Corey plates as the latter plates were to the all-steel and compound plates of an earlier day. Its superiority, as shown by proving ground tests, was so marked that the English Admiralty at once adopted it in place of the Harveyized armor, and it is now being placed upon all the newer vessels of their navy; and after the very excellent results obtained at the Indian Head Proving Ground, and herewith illustrated, it was inevitable that the new armor should be chosen for all our future ships.

The supreme value of the ever increasing hardness and toughness which is being given to armor plates consists in the fact that the new plates enable the total weight of armor with which a ship is clothed to be greatly reduced, and the weight so saved may be appropriated to a more powerful armament, or engines and boilers of greater horse power. Proving-ground tests and experience in actual warfare have shown that the protection afforded by the 15 and 18-inch Harveyized armor of the "Oregon" is amply sufficient to resist modern high-powered rifles. Although the 18-inch belt or 15-inch turrets of the "Oregon" type of ship have never been penetrated in an actual engagement, the behavior of inferior heavy armor at the Yalu and at Santiago proves that the heavy Harveyized protection of our ships renders them practically impregnable against shell fired from the distances at which modern engagements will probably be carried on. This being the case, it follows that every improvement in the quality of the later armor enables us, taking the protection of the "Oregon" as a standard, to make a corresponding reduction in the thickness of the plates.

The improvements introduced under the Corey patents made it possible to increase the tensile strength about 12 per cent and the elongation about 15 per cent over that of the Harvey plates; and now the Krupp gas process enables us to produce a plate of such wonderful toughness and hardness that armor 10 and 11 inches in thickness has all the powers of resistance shown by the 15 to 18-inch armor of the earlier vessels.

Our readers who wish to follow the development of armor plate manufacture will find it treated at some length in the SCIENTIFIC AMERICAN ARMY AND COAST DEFENCE SUPPLEMENT. The Krupp gas process is the latest development in a long line of experiments which has successively provided the world with iron, compound iron and steel, all steel, Harveyized steel, nickel steel, Harveyized nickel steel, reforged Harveyized nickel steel, and Krupp steel. The rights have been purchased in this country by the Carnegie Company, and the second experimental plate recently tested at Indian Head proved to be of exceptionally high quality, even for a Krupp plate. Krupp armor shows remarkable toughness combined with all the hardness of the best face-hardened armor, and, unlike armor manufactured by other well known processes, the Krupp product maintains these qualities in the very thickest armor.

The plate tested at Indian Head measured 5 feet 8 inches by 9 feet by 6 inches. The backing consisted of 12-inch oak and two 5/8-inch skin plates secured to the plate by ten armor bolts. The plate and backing were secured to the normal target structure by four holding-in bolts 1·5 inches in diameter which passed through the backing, and by four similar bolts secured to the exposed vertical edge of the backing. The plate has a good surface and general appearance and was hard to a depth varying from 1·5 inches to 2 inches. The plate was so secured that "top" was the right vertical edge.



1.—REAR VIEW OF 6-INCH KRUPP PLATE AFTER TEST.

First Round.—The gun used was 6-inch rapid-fire. The charge of powder was 22·25 pounds of Dupont's S. P. F. G. 3; the striking velocity, by chronograph, was 2,021 foot-seconds and the striking energy 2,831 foot-tons. The projectile used was a 6-inch armor-piercing Carpenter, hardened to 3 inches below the bourrelet, without cap; weight, 100 pounds. The impact was at a point 39 inches from the bottom of the plate, 58·5 inches from the left edge and normal to the surface. The projectile smashed on the plate, only a small part of the point remaining welded in the plate, a large part of the body and base of the projectile being found in one piece in front of the plate. The estimated penetration was 2·5 inches. A back bulge 1·5 inches high was formed on the rear of the plate. The plate was dished in the vicinity of the impact 7/16 inch. The impact on the surface of the plate covered an area 12 inches in diameter. The plate was not cracked, nor was any injury done to the backing, bolts, or structure.

Second Round.—The same gun, 6-inch, was used. The charge of powder was 25·8 pounds of Dupont's S. P. F. G. 1. The striking velocity was, by chronograph, 2,237 foot-seconds and the striking energy was 3,469 foot-tons. The projectile used was a 6-inch armor-piercing Carpenter hardened to 2 1/2 inches below the bourrelet, without cap, weight 100 pounds. The impact was at a point 19·4 inches from the bottom of the plate, 92 inches from the left edge, 39·5 inches from the previous impact, and normal to the surface. The projectile smashed on the plate. A large part of the projectile remained welded to the plate, judging from the smaller part of body and base found in front of the plate. The estimated penetration was 5 inches. A back bulge 4·5 inches high was formed on the rear of the plate. The plate was dished 1/8 inch in the vicinity of the impact. The impact on the surface of the plate covered an area 10·5 inches in diameter. The flaking extended around the impact to a diameter of 16·5 inches. The plate was not cracked, nor was injury done to the backing, bolts, or structure.

Third Round.—The same gun, 6-inch, was used. The charge of powder was 25 pounds of California S. P. perforated cylinder. The striking velocity was, by chronograph, 2,350 foot-seconds and the striking energy 3,828 foot-tons. The projectile used was a Carpenter 6-inch armor-piercer without cap, hardened to 2 3/4 inches below the bourrelet; weight 100 pounds. The impact was at a point 20·25 inches from the bottom of the plate, 21·5 inches from the left edge, 41 inches from the nearest previous impact, and normal to the surface.

The projectile perforated the plate and broke up all parts, going through the plate and the oak backing; but they were stopped by the skin plating without cracking the latter. The hole made in the plate was of an irregular oblong form, having greatest diameter of 8·5 inches at front and rear and no spur. A part of the plate of the same shape as the hole was driven ahead of the projectile in one piece, as though punched by a powerful punch. The plate was dished 0·3 inch in the vicinity of the impact. The flaking on the front face was 17·5 inches in diameter. The plate was not cracked, nor was any further injury done than that set forth above to the plate, backing, bolts, or structure.

Fourth Round.—The same gun, 6-inch, was used. The charge was 32·3 pounds of Dupont's S. P. F. G. 3. The striking velocity was, by chronograph, 1,984 foot-seconds and the striking energy 2,837 foot-tons. The projectile used was Carpenter 6-inch A. P., fitted with standard cap, hardened to 4 inches below the bourrelet, weight 104 pounds. The impact was at a point 18·25 inches from the bottom of the plate, 9·5 inches from the left edge, 21·25 inches from the nearest previous impact, and normal to the surface. The projectile perforated the plate and broke up, all parts going through the plate, backing, and skin plates, and barely entering the sand butt in the immediate rear of the structure. As in the previous round, the hole made was oblong in shape, with the greatest diameter of 6·75 inches, and practically the same on the front and rear faces. A spur 1·6 inch high was raised about the point of exit. There was no dish in the plate observable about the point of impact. The flaking on the front of the plate was 12 inches in diameter. No other injury than that noted above was done to the plate, bolts, backing, or structure. This plate showed great resisting power.

2.—KRUPP PLATE AFTER ATTACK BY THREE 6-INCH ARMOR-PIERCING SHELLS.

3.—SAME PLATE PENETRATED BY CAPPED SHELL DELIVERED WITH 1984 FOOT-SECONDS VELOCITY.

The notable features were the extreme toughness of the back of the plate and great thickness of the hard face, the comparatively small flaking on the front face, and the entire absence of coning on exit at the rear. The plate was of good appearance as regards surface, both front and rear.

Continued improvement in quality, peculiar to the American manufacturer, will no doubt result in the near future in armor plate manufactured by this process, and the result will no doubt be equally as superior to that manufactured in Europe as is our present ordinary face-hardened armor.

THE "AVION."

The problem of aerostation, that is to say, of aerial locomotion effected by means of an apparatus heavier than the air, is so attractive as to occupy the attention not only of the most extravagant inventors, but of the most conservative and conscientious scientists. How many strange conceptions, from the flying dove (a simple toy) of Architas of Tarentum (from the century before Christ) to the dirigible flying apparatus of Otto Lilienthal, which was much more dangerous, since, in 1896, it cost its inventor his life! How many laborious researches, from those of Roger Bacon and Leonardo da Vinci to those of Maxim, Langley, and Richet! How many disciples on both sides!

Is the "Avion," an apparatus devised and constructed by M. Ader, a French engineer, finally to permit man to realize the legendary dream of Icarus? Perhaps so.

Upon an examination, and at first sight, this Avion is the most seductive flying machine that could be imagined. Will it fly? It is, unfortunately, difficult to be positive as to this essential point, since up to the present the machine has done so little flying!

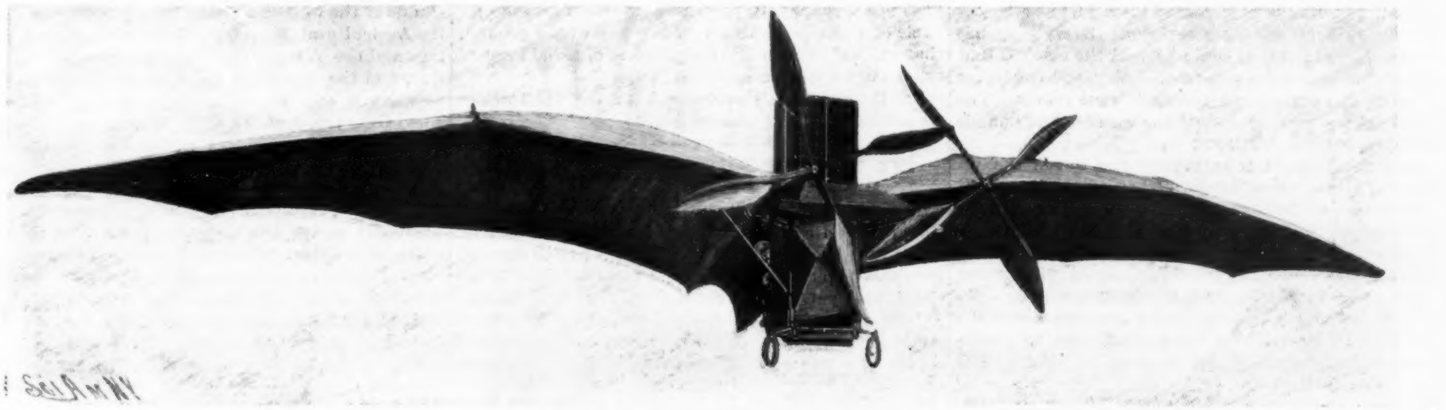
M. Ader has been able to attempt an experiment but once. A fortuitous accident interrupted the experiment at the precise moment at which it was about to prove conclusive in one direction or the other, and the apparatus has therefore failed to show what it is capable of doing.

M. Ader, like all those who, before him, have conceived the idea of rising, moving, and steering themselves in the air, has for a long, very long time studied the flight of birds, and the organs of such flight, the wings. He has doubtless brought to this study more shrewdness than was possessed by his predecessors and his rivals, since he has made one discovery that did not enter their heads. He has observed that for the organs by which birds are sustained in the air Nature has adopted a well defined, special geometrical curve, developing from front to rear in the direction of the motion. Each feather taken separately obeys the same law. The curve is more or less pronounced according to the charge of the wings, but the spiral is found always and everywhere in the wing of all birds—in that of bats, in that of insects, and in the structure of everything that sustains itself in the air. There is here a principle from which Nature never departs, and which, according to M. Ader, constitutes the basis of aerostation.

In order to sustain his mechanical bird upon the atmospheric strata, M. Ader has, therefore, deliberately abandoned the plane surfaces of the Maxim and Richet apparatus and substituted therefor incurved surfaces—true wings, characterized, like the mysterious boomerang of the Australian aborigines, by the indispensable spiral.

With such a starting point, the Avion should certainly offer a general resemblance to the body of a bird with outspread wings. Such resemblance will certainly be objected to on the score of not being very scientific and of giving the machine the aspect of a gigantic and puerile plaything. But M. Ader makes no concealment of his intentions; it is really a mechanical bird that he has desired to construct (just as was done by the Franconian astronomer J. Muller in the fifteenth century), but with all the means placed at his disposal by modern science and industry.

As may well be imagined, the copy of the bird is not servile. The wings of the Avion are not composed of artificial feathers. They reproduce those of the bird especially by the distribution of resistances. The frame, which is made of sized bamboo fibers, is hollow and of extreme lightness and rigidity. Ribs of steel wire (true tendons) hold them in position. The sails or membranes that serve as a support in the air are of silk. These wings, jointed in all their parts, are capable of being folded up compactly. They serve for sustentation merely, and do not flap. They are movable at the shoulder only from front to rear, in order to permit of modifying the center of gravity of the apparatus. The propeller of the Avion is a screw, which, in the air, replaces the flapping wing of the bird, as in water it replaces the fin of the fish. The four-bladed screws constructed by M. Ader are of bamboo fiber, light and rigid, two in number, and situated in front. They revolve in opposite directions, in nearly the same plane, and are entirely independent. The motor that drives each of them is a marvel of power condensed into small bulk and feeble weight. The motive power is furnished by steam. The



THE "AVION" IN ITS POSITION OF FLIGHT.

THE "AVION" WITH THE WINGS FOLDED.

fuel employed is alcohol. Each of the motors has four cylinders and operates by double expansion. The generator is tubular and the vaporization therein is, so to speak, instantaneous. When all the exits are closed to the steam, the pressure rises one atmosphere per second. The waste steam liquefies in an air condenser that is placed at the top of the apparatus, and that permits of recovering the water without the loss of a particle.

Each motor is of 20 horse power. All the parts were worked out of blocks of forged steel, just as a bust is carved out of marble by a sculptor. Everything has been hollowed out that could be, and the result is that the total weight of the generator, motor, and condenser is about 6¼ pounds per nominal horse power. The motor alone does not exceed the weight of 2¼ pounds per horse power.

As each motor directly actuates one screw, the velocity of either can be diminished at will. The result is that, in the steering, the propellers concur with the independent rudder situated at the rear. The latter is maneuvered by the aeronaut by means of pedals. Three or four buttons or handles, placed within easy reach, suffice for all the other maneuvers.

Such, in its main features, is the arrangement of the Avion. The model that we were allowed to photograph in M. Ader's shop has a spread of wings of 48¾ feet. The total weight, exclusive of that of the aeronaut and the fuel, is 568 pounds. With a complete load, the weight will reach 1,100 pounds. The wings are charged with from half a pound to a pound to the square foot, according to the weight of the aeronaut, the fuel, and the accessories.

The problem of aerial navigation is not only a scientific, but, just at present, a military one. Is it possible to think without terror of the day on which flying apparatus—mechanical birds—will rain down the most deadly and destructive explosives upon armies, squadrons, and hostile cities? To such torpedo throwers it will be possible to oppose only similar apparatus. So in all countries, in America as well as in Europe, eminent men are endeavoring to realize aerostation, which doubtless will soon appear ripe for practical applications, and especially for the terrible business of war, at several points at once.

It was under the auspices of and through subsidies granted by the French War Department that the Ader Avion was constructed (in the profoundest secrecy) between 1892 and 1897, under the surveillance of a commission composed of three generals and two members of the Institute.

In the month of October of last year, the apparatus having been finished, haste was made to experiment with it upon the Satory field of maneuvers. A great circular track, 1,475 feet in diameter and 130 in width (much preferable to a straight and necessarily limited one), was established by military authority. The earth was cleared of sod and then beaten and rolled perfectly smooth.

Gens. Mensier and Grillon, who are well versed in such matters, had been requested to be present at the experiments in an official capacity. The experiments were put off from day to day for nearly a week, on account of the wind being too violent. Finally, on the 14th of October, taking advantage of a calm, M. Ader got into his machine and set it running. Mounted upon wheels, and with the wings outspread like a huge bat, the apparatus first passed over the track at a moderate speed, while numerous sentinels prevented anybody whatever from approaching the field of experiment.

The speed of the Avion progressively increased, and M. Ader felt and the spectators perceived that the wheels were leaving the earth. The apparatus, free for an instant from any supporting point, veered slightly and directed itself against the wind. But at this moment a squall supervened, and the inventor, afraid of being carried along by it, diminished his velocity. The wheels then touched the ground again, but, having a fixed direction, and the apparatus having taken a position that was oblique with respect to the direction of its motion, they could no longer roll. There was a disaster. The extremity of one of the wings came into contact with the track and was broken; the machine upset, the propellers were shattered, and the motors alone remained intact. M. Ader, fortunately, got off safe and sound, but the experiments were, of course, interrupted.

Gen. Mensier addressed to Gen. Billot, then Minister of War, a report in which the recommendation was made that the researches be continued and the experiments be renewed, and in which the opinion was given that results so important ought not to be disregarded.

In spite of the unfortunate accident, it was ascertained, in fact: 1. That the motive apparatus, through its power, lightness, and ease of management, answered the requirements of aerostation; and, 2, that the wings were capable of carrying the entire mechanism, the accessories, and the aeronaut.

M. Ader's flying machine, now repaired, has been provided with loose wheels that will prevent the recurrence of such an accident as that which happened at Satory. They, in fact, permit the apparatus to direct itself upon land as well as in the air, obliquely with respect to its motion forward.

The resumption of the experiments with the Avion will depend upon the Minister of War. Such experiments are not to be reckless ones, but merely progressive and prudent tentatives, having an appropriate ground as a starting point and requiring favorable atmospheric conditions.

We shall, perhaps, see the Avion soar, neither very high nor very far. If it merely describes an arc of a circle of a hundred yards at a few feet above ground, that will suffice to allow the problem of aerial locomotion to be considered as solved.

For the above particulars and for the illustrations we are indebted to L'Illustration.

THE TRANS-MISSISSIPPI AND INTERNATIONAL EXPOSITION.

The success of the Trans-Mississippi and International Exposition, at Omaha, is no longer prospective. Since June 1 nearly 1,000,000 people have passed through its gates to enjoy this splendid creation of Western thrift and enterprise. Second only to the World's Fair in the multitude and excellence of its exhibits, it rivals it in harmony of architectural conception and scenic development. The promoters are certainly justified in their belief that the success of the enterprise gives promise of a broader prosperity for the great West.

That characteristic Western energy that has made metropolitan cities of frontier trading posts within the memory of a living generation is again emphasized in the development of this exposition. In exactly thirteen months from the day on which the first shovelful of earth was lifted, the work was complete. This was accomplished in the face of the ever memorable financial and industrial depression of recent years, which had fallen with crushing force on the territory from which the inspiration and material resources of the enterprise were derived.

The project for an international exposition in Omaha originated with Edward Rosewater, editor of The Bee, who has since been one of its most active promoters. In the session of the Trans-Mississippi Congress in Omaha in November, 1895, he saw an opportunity to give substantial impetus to his plan, and after consultation with some of the leading business men of the city, it was outlined in a vigorous editorial in his paper. It was backed by arguments that won the immediate co-operation of the delegates to the congress. Two days later the resolution which declared in favor of the project and called on the United States government to support it was introduced by William J. Bryan and adopted unanimously amid the greatest enthusiasm. The congress adjourned and left to the citizens of Omaha the task of organizing the enterprise. This required thorough consideration, and it was nearly two months later when it was formally effected. The capital stock of the Trans-Mississippi and International Exposition Association was fixed at $1,000,000, payable in shares of $10 each. The association was authorized to transact business as soon as $10,000 was subscribed, and this was accomplished in five minutes. A board of eleven directors was elected, which was afterward increased to fifty, and twenty-five vice presidents, one from Omaha and one from each of the Trans-Mississippi States. The permanent officers elected were: Gurdon W. Wattles, president; Alvin Saunders, vice president; Herman Kountze, treasurer; John A. Wakefield, secretary. The active management of affairs was vested in an executive committee which consists of Z. T. Lindsey, manager department of ways and means; Edward Rosewater, manager department of publicity and promotion; F. P. Kirkendall, manager department of buildings and grounds; Edward E. Bruce, manager department of exhibits; A. L. Reed, manager department of concessions; and W. N. Babcock, manager department of transportation. These are all well known business men of Omaha.

To finance successfully such an ambitious enterprise and work out the many problems that occurred in connection with its construction was a discouraging task, in view of the conditions that prevailed. Nearly $2,000,000 was expended in the improvement of the grounds and the construction of the buildings, exclusive of the large investments made by exhibitors and concessionaires. The result is the best indication of the ability and industry that it involved.

The Omaha exposition was exceptionally fortunate in finding a location within ten minutes' ride of the business center of the city. The site includes about 200 acres of territory that was especially adapted to the general plan of improvement. It is divided into three nearly equal parts, each adjacent to the others, but characterized by some slight differences in decorative effects. The main court occupies a level tract 3,000 feet wide and 800 feet long, around which the main buildings have been united in an oblong circle that is completed by connecting colonnades.

The center is occupied by the lagoon, which is 150 feet wide, except at the west end, where it is drawn out in a trefoil design to a width of 400 feet. The walls of the lagoon are constructed to represent solid masonry relieved by occasional terraces of turf and flowers. It is surrounded by a broad expanse of brick pavement, which extends back to a similar belt of beautifully parked greensward that separates it from the colonnades and buildings. These surround the court in a solid circle of white architecture. While each building presents a different phase of architectural conception, they all blend in a wonderfully pleasing harmony of outline. The Government building stands at the west end of the lagoon facing the mirror, the Agricultural, Manufacturing and Machinery buildings and the Administration Arch occupy the north side, and the buildings devoted to fine arts, liberal arts, mines and mining and the Arch of States face them from the opposite side. The circle is completed by the handsome viaduct at the east end, which is flanked by two lofty casinos, which tower over the entrance.

The bluff tract, which lies on the Missouri bluff immediately east of the main court, contains the Horticultural building, the various State buildings, and the East Midway. Here the triumph of the landscape gardener is most apparent, and the sixty acres of rugged bluff has been invested with the charm and beauty of an oriental garden. Over twelve thousand trees and shrubs were planted in this portion of the grounds alone, and over one hundred thousand plants and flowers bloom in the midst of its luxuriant greensward.

The north tract is situated immediately north of the main court, with which it is connected by a broad boulevard. It contains the Transportation, Dairy, Apiary, and Poultry buildings, the West Midway, the Indian encampment, and various other features for which less imposing architecture is required. Aside from these principal buildings, the architectural features include a large auditorium, an International hall, where the exhibits of France, Italy, Mexico, Canada, and other foreign countries are displayed, a Boys' and Girls' building, erected with the contributions of the school children of Nebraska and Iowa, and service, jail, hospital and various other structures essential to the active operation of the show.

The main exhibit buildings afford an aggregate floor space of 5' 0,000 square feet, exclusive of the galleries. The exact distribution of space and the dimensions of the buildings are indicated as follows:

	Width. Feet.	Length. Feet.	Floor Space. Feet.
Administration Arch	50	50	2,500
Agriculture	143	400	58,449
Fine Arts	125	246	31,762
Liberal Arts	130	241	33,018
Machinery	144	304	49,197
Manufactures	152	400	56,898
Mines	140	304	49,224
Transportation	249	432	107,568
Government	100	424	47,515

The Horticultural building consists of a central dome 108 × 120 feet and two wings each 74 × 97 feet, with a floor space of 26,732 square feet.

The amusement features of the Trans-Mississippi show comprise all the novelties that have become popular at previous expositions, and a number of newer features that represent a distinct advance in Midway attractions. The district occupies two streets, one on the bluff tract and the other on the north tract, which are united by a handsome viaduct. The Streets of Cairo and the Streets of all Nations represent the oriental features that have been the peculiar characteristic of Midway amusements. At Omaha they are installed on a broader and improved scale, as suggested by the experience of previous expositions. The Chinese village is the abiding place of nearly two hundred Chinese, representing all classes of Chinese life, and here are illustrated their customs, amusements, industries, and religious ceremonies. The Moorish village contains a number of striking features, including a palace of wax figures valued at fifty thousand dollars, and a variety of illusions and mechanical effects. The Japanese village and the German village illustrate other phases of foreign life, and the cosmopolitan features of the Midway include types of nearly fifty different nationalities.

Aside from these, the Midways contain nearly fifty novel mechanical and scenic features, which have been carefully culled from hundreds of applications. Hagenbeck's, the ostrich farm, an excellent Wild West show, cycloramas, and illusions of various types afford a wide variety of entertainment. The shoot the chutes, scenic railway, miniature railroad, and other novelties are entirely new, and the giant seesaw is a feature that is inherited from the Nashville exposition.

The north tract is also the home of nearly one thousand Indians, representing thirty distinct tribes, who have been mobilized by the United States government to illustrate the customs and amusements of an almost extinct race. Here the red men live in their characteristic habitations and wear their native attire of paint, blanket, and feathers. Exhibitions of their sports, dances, and amusements are given daily, and these constitute one of the most instructive and fascinating features of the exposition.

Manchuria.

Away on the extremely opposite end to ours of the great Eurasian continent is a country to which only too little attention has as yet been paid, and which, on account of its wealth, its favorable natural position, and the intelligence of its inhabitants, will attract to itself a yearly increasing notice from Europe, and play no insignificant part in the history of the next few decades. The recent march of events has shown two rising powers pressing round Manchuria, and threatening to contest its possession with the seemingly dormant Chinese. . . . If Manchuria were such a wretchedly poor country as, for instance, Khiva, Merv, and Turkestan, and others which have fallen to the lot of the Russians, comparatively little attention need be paid to the progress of events in that distant quarter of the world. It would matter but little to other European nations whether the Russians or Japanese did or did not take the country. But Manchuria is no such desert country. It is, on the contrary, a country of exceeding richness, and of promise scarcely less than that of the Transvaal itself, and compared to which the whole of Central Africa, from Uganda to Khartoum, is of paltry insignificance. . . . The timber alone in the vast virgin forests which clothe the hill-sides over thousands of square miles must be worth many millions: for this timber is of the most valuable kind, and besides the ordinary pines, which are common all over the world, and which, being fast growing, are easily replaced when cut down, there are immense quantities of hard timber—of oak, and elm, and walnut—to replace which a century is required, and the quantity of which in the world is rapidly diminishing. . . . Manchuria is equally rich in its production of cereals and in the southern portion of such crops as indigo and tobacco. . . .

Such being the climate, the nature of the country, its soil and productions, the inhabitants, as might be expected, are a strong, hardy, vigorous race, and from the glens of Manchuria have issued three successive waves of conquest which have overrun the whole of China. The number of the original inhabitants has been augmented by streams of immigrants from China proper, and these, though slightly less robust than the original Manchus, are yet of good and sound physique. They are the very reverse of impulsive—cool, calculating, provident, and so economical that not even the manure from off the roads is allowed to be wasted, and the heat of the fire required for cooking purposes is carefully utilized by means of flues to warm the whole house. Their industry is apparent in the care bestowed upon their fields. In the summer they work from dawn till sunset, with a brief interval for the midday meal, and in the winter they start hours before daybreak on their long carrying journeys. They are grave and little given to mirth; on the whole, law abiding, amenable to control and to the restraints of social life; if not particularly warm in their devotion to their children and to their parents, at any rate not absolutely callous; and though any active benevolence is not very apparent, there are, on the other hand, few symptoms of active malevolence. But the most important trait to notice is their strong conservatism. What was good enough for their fathers the present-day inhabitants think must be good enough for them. They are intelligent and quick to grasp simple ideas, but superstitious and ignorant of natural causation; very lacking in imagination, with high powers of imitation, but no capacity for invention. They all dress alike, and in the same way in which they have dressed for centuries past; there is no difference between one house and another, and even their carts are all of the same pattern. The rigid fixity of ideas is a concomitant of their strong conservative proclivities. They have, as a rule, little regard for truth, but, in business matters, once their word is given, it may be relied on. Honesty is not a pronounced trait in their characters, nor are they remarkable for morality. And these defects must, therefore, be set against their striking industry and thrift. Their religion seldom shows itself, and has little effect upon their practical conduct. It produces in them none of that fanaticism which impels other races of Asia to deeds of war, and it imposes upon the people of Manchuria few of those restrictions as to what they may or may not eat or do with which the people of India are so fettered.—Capt. F. Younghusband, in The Nineteenth Century.

Coal Output of Natal.

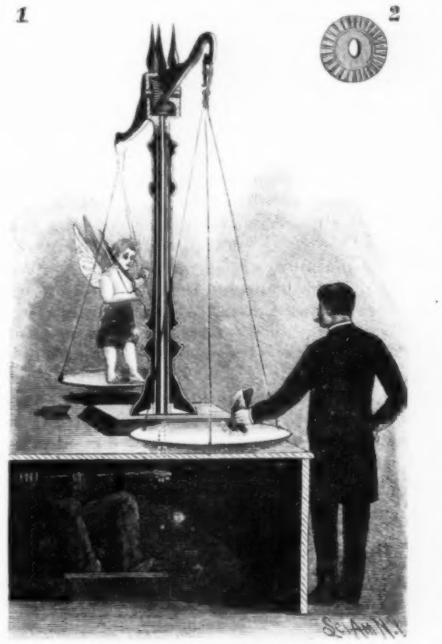
At a recent South African banquet, Sir Walter Hely-Hutchinson mentioned that the monthly output of coal in Natal had increased from 12,000 tons in 1893 to 30,000 tons in 1898. He added as a notable fact that on April 16 last the ships in Durban Harbor loaded 1,000 tons of coal in the day.

"CUPID LIGHTER THAN A BUTTERFLY."

BY W. E. ROBINSON.

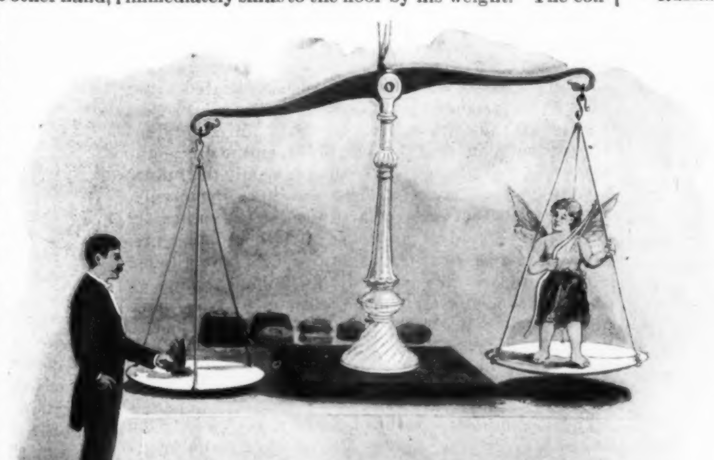
The pleasing trick which forms the subject of our engravings owes its success to the ingenious application of mechanical principles. The magician presents for inspection to the audience a large pair of balance scales. The audience is allowed to examine the various parts of the balance before it is erected on the stage. It consists of a central column and a beam resting on a knife edge and two pans suspended by cords or chains. After the column has been put in position, the beam is put on and a pin inserted, thus making a center for the beam to work on. A gentleman is asked to stand in one of the scale pans and then weights are gradually placed in the other pan until his exact weight is ascertained. The weights are removed and the gentleman steps down off the stage. The audience is now convinced that the scale is to all intents and purposes like the ordinary balance which is so much used in groceries for weighing tea, coffee, etc., although, of course, in the present instance it is built on a mammoth scale.

1 2



THE ILLUSION EXPLAINED.

The magician now goes on to say that he will prove the old assertion that "love is lighter than a butterfly" to be absolutely true. He introduces a little boy dressed as Cupid, with wings and a bow and a quiver of arrows. When the child steps on the scale pan, it immediately sinks to the floor by his weight. The conjurer now takes a butterfly, and, asking all to direct their attention to the scale, drops it on the opposite pan, which immediately descends to the floor, at the same time raising the pan with the Cupid high in the air. If he takes the butterfly off, the Cupid descends, and every time the prestidigitator replaces the butterfly, Cupid is raised off the floor.



"CUPID LIGHTER THAN A BUTTERFLY."

The trick depends for success upon a carefully devised and concealed mechanism. The balance beam is devoid of any preparation, but the mechanism is cleverly concealed in the column, and motion is imparted to the beam by means of a shaft and bevel gears. The hole in the beam is not perfectly round; it is slightly oval, but not enough so to be easily seen by a casual glance. The pin is also oval, instead of round, and it is made to fit tightly. It will be seen that, when this pin is rocked or tilted, the beam is moved, carrying one scale pan up and the other down. The top of the column is of considerable size, and one side of it is cut away to admit of a bevel gear, which also has an oval hole the same as the beam. When the balance is put together and the beam is placed in position, the oval pin passes through the bevel gear and the beam, forming a horizontal shaft. This vertical wheel meshes with a horizontal gear wheel, which is also secured in the head of the pedestal. A shaft runs through it to the space below the floor, where it terminates in a lever secured at right angles. The magician's assistant, under the stage, grasps the lever, and, pulling it back and forth, transmits a seesaw motion to the beam through the medium of the shaft, the two bevel gears, and the oval pin.

The trick depends very largely for success upon the apparent willingness of the prestidigitator to allow all parts of the apparatus to be examined, and, as the gear wheels are very cleverly concealed, there is almost no chance of the trick being discovered.

The Desolation of Cromer.

The recent landslip at Cromer, England, is only the last of a long series of catastrophes which during the past thousand years have buried more than a mile of land in the sea. One looks in vain for any mention of Cromer in Doomsday Book. It was then but a hamlet of the town of Shipden. But Shipden has lain now for many years at the bottom of the sea. At the beginning of this century it was still possible to discern the masonry of its church at low water. In those days Cromer was an inland town. But in 1837 an extraordinary gale drove the sea to such a height that the very existence of the town was in peril for many hours. Since then a breakwater has been constructed to protect the town. The neighborhood, however, is gradually disappearing. At Sheringham a frigate drawing 20 feet of water can now ride at anchor where forty years ago there was a cliff 50 feet high. It has been found necessary to move various buildings inland. A lighthouse was built in 1719 several hundred yards inland, but in little more than a century this lighthouse had to be abandoned, owing to encroachment, and a new one built still farther away. The Cromer cliffs are very sandy, and are especially exposed to the action of the sea, as they encounter the full force of the drift from the northeast.—Westminster Gazette.

Russia in Central Asia.

A Russian vice-consulate has been established at Seistan, in the frontier sphere which Great Britain created between her protectorates of Afghanistan, Baluchistan, and Persia, something like a quarter of a century since, which leads the National Zeitung (Berlin) to give expression, editorially, to the following:

"Russia, which already has her claws around the Afghan city of Herat, is now stretching out her feelers further south against the outposts of the Anglo-Indian dominion. The Czar is preparing to send out a 'scientific' exploring expedition under Prof. Soroki, of Kazan, to Lake Lob Nor, in Chinese Turkestan, which, owing to the insecurity of the country, will require a by no means inconsiderable escort of Cossacks. This will probably turn out to be another of those numerous 'scientific' expeditions which Russia has been in the habit of sending to Central Asia of late years, to pave the way for annexation. The speech made the other day by the new governor-general of Turkestan to the Mohammedan notables of Tashkend, after the suppression of the revolt in Ferghana, ran as follows:

"'Be assured that all the Mohammedans here, taken together, form but an unimportant and imperceptible part of the millions of Russia. The great Czar has such a number of faithful servants, and his brave army is so large, that, if necessary, he can within a week or two bring men enough here to quarter a whole battalion in every village. The people must, therefore, remain peaceful and quiet. And what would you gain by hostility? The Czar has bestowed full liberty and the possibility of living according to their religion on all his faithful subjects, including the Mussulmans here.'"

Ivory Veneers.

Veneer cutting has reached such perfection that a single elephant's tusk 30 inches long is now cut in London into a sheet of ivory 150 inches long and 20 inches wide, and some sheets of rosewood and mahogany are only about a fiftieth of an inch thick.

THE HEAVENS IN SEPTEMBER.

BY GARRETT P. SERVISS.

During the first fall month the constellations which characterized the summer sky are beginning to pass successively from sight, while those that adorn the autumn evenings begin to advance from the east. In this transition period a description of the stars of autumn may, perhaps, better be postponed until next month.

THE PLANETS.

Mercury, which was visible in the west during August, passes its inferior conjunction with the sun on the 5th of September, becoming a morning star and attaining its greatest western elongation on the 21st. Mercury remains in the constellation Leo throughout the month.

Venus, having continued its eastward motion since its conjunction with Jupiter, in August, is found at the beginning of September in the constellation Virgo, four or five degrees east of the brilliant star Spica. At the middle of the month it crosses over into Libra, going fast toward the south. Venus attains its greatest elongation east of the sun on the 22d, at very near the same time when Mercury is at its greatest western elongation.

Venus rapidly increases in brilliancy during September, although the ratio of the illuminated portion of its disk as seen from the earth is constantly decreasing. Viewed with a telescope, Venus will appear in the form of a half moon about the 20th. Its increase in brightness is due primarily to the fact that it is swiftly approaching the earth, between which and the sun it will pass in October. Its brilliancy at the close of the month will be about one-third greater than at the beginning. The mystery of its rotation still remains unsolved, although upon its solution depends the question of the habitability of the planet by beings in any degree resembling ourselves.

Mars, remaining in the constellation Gemini through the month, and moving slowly eastward, is still a morning star, and although improving in position, is not yet a very interesting object for the telescope. Although an exterior planet, Mars exhibits phases and will be seen slightly ovoid in form, with a white patch due to the polar snow, visible with a good telescope at one end of the elliptical disk. Not much news concerning Mars is to be looked for before the conjunction of 1899.

Jupiter is still to be found in the constellation Virgo, where its meeting with Venus occurred in August. It disappears so soon in the evening twilight of September that before the end of the month it will have ceased to be a very conspicuous phenomenon.

Saturn still loiters in Ophiuchus, near the northern border of Scorpio and not far from the red star Antares. During the month Saturn will be the planet best situated for observation in the evening, not even excepting Venus, for, as was remarked last month, the best time for telescopic study of Venus is not after sundown, when the planet is seen blazing in the twilight, but in broad day, when it must be found from a knowledge of its exact position in the sky. The excessive brilliancy of the disk of Venus as compared with that of Saturn is a very interesting peculiarity, depending not merely on the difference of the distance of the two planets from the sun, but more especially upon an essential difference in their atmospheric surroundings.

Uranus remains on the borders of Libra and Scorpio, and Neptune, as a morning star, remains in the constellation Taurus.

THE MOON.

September opens with a waning moon. The new moon of the month occurs on the evening of the 15th; first quarter on the evening of the 22d, and full moon on the evening of the 29th. The last quarter of the preceding moon falls on the evening of the 7th. The moon is nearest to earth near midnight on the 24th and at its greatest distance on the evening of the 9th.

The conjunctions of the moon with the planets occur in the following order: September 8th, Neptune; 9th, Mars; 14th, Mercury; 17th, Jupiter; 19th, Venus; 20th, Uranus; 21st, Saturn.

The sun enters Libra and the astronomical autumn begins on the 22d, at 7 P. M., Washington mean time.

Boric Acid in Wines.

P. Carles points out that boric acid is present in many wines in notable proportions, and that it is found more frequently in white than in red wines. This is partly due to the fact that the clarifying agents generally employed, e. g., gelatin and isinglass, tend to putrefy unless an anti-ferment is present. For many years H_2SO_4 has been used for this purpose, but among its disadvantages it deprives red wines of their color, and is readily detected by its odor. Another reason for the use of boric acid is the demand for sweet white wines, hence its addition in order to check fermentation at a certain stage in the process. It is, of course, open to question whether, from a hygienic point of view, the use of boric acid is permissible in articles intended for human consumption, on account of its antiseptic properties.—Rép. de Pharm.

Science Notes.

After all public works in New York city have been stopped, under the new city administration, we are glad to learn that the Board of Estimate and Apportionment has authorized the reissue of $375,000 in bonds for the construction of buildings for the Botanical Garden in Bronx Park. Work on the Museum building is being carried forward, the contract calling for its completion early next year.

The Manitou and Pike's Peak Railroad has just signed a contract for a large observatory to be built on the top of Pike's Peak. The tower can be seen for miles. The structure will be built very solidly, so as to withstand the terrible wind and snow storms which rage in winter over the barren top of the Peak. There will be four large telescopes mounted in the tower for observation purposes. With these it will be possible to see Denver, fifty miles to the north, and to the west Cripple Creek.

Successful demonstrations are reported to have been given in London by Lawson Tait with his electric hemostat, an instrument which, as the name denotes, is intended for the arrest of bleeding in surgical operations. A platinum wire, arranged to carry a current, is inclosed in the blades of a pair of steel forceps or any other requisite utensil, the wire being insulated by a bed of burnt pipe clay. In practice, a current of suitable voltage is turned on, the artery seized and compressed, and in a few seconds the tissues and arterial walls are so agglutinated that the passage of blood is rendered impossible. The temperature employed is about 180° Fah., showing a great difference between this and the electrical cauterizing instruments, and the necessity for a ligature is removed.

At a recent meeting of the Royal Dublin Society, Dr. F. T. Trouton communicated a method of measuring the surface tension of liquids which depends on the rate at which a column of liquid fills or empties itself out of a tube of fine bore, says The London Engineer. The tube is placed horizontally and has one end bent downward into a vessel of the liquid. By altering the level of the liquid it can be either arranged to measure the rate the tube fills, in which case the capillary forces draw the liquid up, or the rate of emptying, the capillary forces retarding. Were the flow viscous, the distance traversed would be proportional to the square root of the time. This was shown to be approximately true. Experiments were described using an inclined tube with a wide bent-down portion attached to the lower end. The rate of emptying could be made constant by making the height of the liquid in the wide part equal to the capillary elevation in the fine tube. Experiments were also described made with liquids such as soap solution, where surface tension varies with time.

The French expert in instantaneous photography, M. Marey, has been making an interesting study of the muscles during work. Says Cosmos in its report of the Academy of Sciences: "The mechanism of locomotion is very complex. The work of Mr. Marey has already elucidated a number of points, but he finds that the information at hand is yet very incomplete, and to get a surer base for deduction it is necessary to collect new facts. The obtain these complicated data, the process is somewhat laborious, but the results that it gives are quite worth the trouble. M. Marey indicates the plan that he employed, embracing eight successive operations. We shall notice only the fundamental ones. They consist in obtaining by chronophotography the series of attitudes of the animal in the acts to be studied, and then in killing it and preparing its skeleton, so that this can be photographed in the same attitudes as the living animal. Thus we have the elements for a complete study of the muscular system. M. Marey has applied his method to the horse, and gives very complete details of the series of successive operations and the deductions that can be made from them."

The Russian Geographical Society has undertaken to make, every year, a series of accurate measurements of certain glaciers, located for the most part in the Caucasus, says The Evening Post, with a view of determining any change in their bulk. In the case of eight glaciers upon which measurements have been made during the last eight or ten years, it was found that they have been steadily decreasing, the lower ends having retreated at an average speed of from 9 to 38 meters every year. Considering separately the northern and southern slopes of the Caucasus, the average speed of retreat of the former was found to be 22 meters per year, while the latter was 25 meters. In 1896 a number of new glaciers were discovered, while in Turkestan an exploring expedition in the Hissar range encountered a large number, several of which had as high an altitude as 13,000 feet at their highest point and sloped down to 10,000 or 11,000 feet at the lowér end. Expeditions to Siberia have also secured considerable information of the glaciers of that region, about which previously little was known. In all cases careful investigation of their condition revealed the fact that they are constantly becoming smaller.

Naval Show at Madison Square Garden.

Frequenters of Madison Square Garden, New York, will find that the appearance of that famous place of recreation has been entirely changed by the naval spectacle which has been produced by Imre Kiralfy. The vast arena in which has figured every possible form of entertainment, from horse shows to charity bazars, is now occupied by a vast tank of water, which is intended to represent the naval battle grounds of the Spanish war. The tank is built of wood and leaded internally to make it watertight. It is some five feet in depth, and the circumference of this inland sea measures no less than one-ninth of a mile. At one end is a proscenium arch, provided with "drops," "curtains," "flies," "wings," and all the etcetera of a regular theater stage, the stage floor in this case being the waters of the tank. Within the stage are represented successively the city of Manila and the entrance to Santiago, and the engagements at these places are simulated by means of models of warships which are moved by man power over the surface of the tank. The stage illusions naturally call for a sympathetic and imaginative audience for the realization of the full effect; but with the stirring events of the war vividly in mind, the "spectacle" proves to be thoroughly entertaining.

The Laughing Plant.

This grows in Arabia, and derives its name from the peculiar intoxication produced in those who partake of its seed. It is of moderate size, with bright yellow flowers and soft velvety seed pods, each of which contains two or three seeds resembling small black beans. The natives of the district where the plant grows dry these seeds and reduce them to powder. A small dose of this powder has effects similar to those arising from the inhalation of laughing gas. It causes the soberest person to dance, shout, and laugh with the boisterous excitement of a madman, and to rush about, cutting the most ridiculous capers for nearly an hour. At the expiration of this time exhaustion sets in, and the excited person falls asleep, to wake after several hours with no recollection of his antics.

The botanical classification of the growth has not yet been identified.—Montreal Pharmaceutical Journal.

The Current Supplement.

The current SUPPLEMENT, No. 1182, is of special interest, both on account of the variety of its contents and the quality of the articles. Probably the most valuable article in the number is "The Utilization of 110 Volt Electric Circuits for Small Furnace Work," by N. Monroe Hopkins. This article is accompanied by detailed instructions for the production of calcium carbide and other directions and working notes. There are eight working drawings, which give a very clear idea of the method of constructing a furnace. For a long time our readers have desired information regarding electrical furnaces which they can make themselves, and this very full article is published in response to their request. "The American Smokeless Powder," by F. M. McGahie, is a valuable paper, giving much information unpublished on smokeless powders, and it is referred to editorially on another page. It is illustrated with diagrams. "On the Position of Helium, Argon, and Krypton in the Scheme of the Elements" is an article by Sir William Crookes, showing a remarkable model which he has constructed, showing the relative position of the elements. "New Constituent of Atmospheric Air," by W. Ramsay and M. W. Travers, also deals with "krypton," and is the original memoir presented to the Royal Society. "Profitable Toilet Preparations" gives a large number of formulas for easily made and high class preparations for the toilet. "The De Laval High Pressure and Steam Boiler Turbine" describes an interesting system, which has elicited much attention at the Stockholm Exposition. "The Performance of the 'Oregon's' Engines on their Great Run of 15,000 Knots" is a technical description by First Assistant Engineer Offley, of the "Oregon," and is referred to editorially elsewhere. "Natural History of Locusts" is a popular illustrated article of great interest. There are a number of minor practical articles of great interest.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Engineering Improvements.

DRAFT DEVICE FOR LOCOMOTIVES.—MICHAEL KELLY, Bloomington, Ill. In order to improve the draft in locomotives, this inventor provides a closed fire-box and an air-supplying apparatus. This air-supplying apparatus comprises a pipe leading from the ash-pan forward to the end of the locomotive and terminating in the open funnel, and a pipe leading from the rear end of the ash-pan and branching to each side. Each branch terminates in forwardly-extending funnels located outside of the engine parts. A common connection of these pipes with the ash-pan is provided whereby the air is discharged beneath the grate to produce a more perfect draught than has hitherto been attained.

SMOKE-CONSUMING FURNACE.—JOHN IMHOF and SAMUEL SPRING, Allegheny, Pa. This furnace has two bridge-walls, located one just back of the grate and the other near the rear of the boiler, and forming between them a combustion chamber. The bridge-walls are composed of fire-brick loosely piled, so as to leave passages between successive bricks in a row and extending upward almost into contact with the boiler. The openings in the forward bridge-wall are uniform in size and the passages through the rear bridge-wall are of a larger area than those through the front bridge-wall. The lower course of bricks in the rear bridge-wall is on edge and extends with its length longitudinally of the boiler. The next course is laid flat and extends with its ends upon the bricks beneath, thus forming a series of enlarged openings at the opening of the chamber, whereby the cooler gases at the bottom of the chamber are discharged most rapidly.

Mechanical Devices.

BALL-COCK VALVE.—JAMES H. MCPARTLAND, Houlton, Me. The purpose of this invention is to provide a simple and durable ball-cock valve which permits the height of the water in the tank to be regulated and permits the closing of the supply pipe whenever necessary. The valve comprises a conveying pipe formed at its end with a valve seat, a tubular valve-casing fitted to slide on the exterior surface of the pipe and having an outlet in its side, and a valve-plug screwing in the casing and adapted to be seated on the valve-seat. By screwing the plug outwardly or downwardly, the level of the water in the tank is respectively raised or lowered.

PNEUMATIC PROPELLER FOR VESSELS.—ANDREW J. CULBERTSON, San Andreas, Cal. In this invention a hull is provided of such construction that the water will have the least possible frictional engagement with the vessel. By forming a series of channels open at the bottom and at the stern, it is possible to interpose currents of air at various points between the hull and the water for the purpose of forcing the vessel ahead and assisting the driving mechanism employed and preventing the water from retarding the progress of the vessel. By providing the vessel with a number of connected auxiliary rudders, it is possible to steer the vessel with great rapidity merely by moving these rudders simultaneously to port or starboard.

Railway Appliances.

REFRIGERATOR-DOOR.—ANDREW J. MCARTHUR, Gainesville, Fla. This invention provides a door for refrigerator-cars and cold-storage rooms. By a simple arrangement, the packing devices carried by the door are prevented from being expanded when the door is opened. The door cannot be forced open while the packing devices are expanded. The door has a number of packing-bars around its edge. Each bar has a vertical and a horizontal portion. Expanding blocks engage with the beveled ends of the packing-bars. Between the blocks and packing-bars are link connections. Links also extend from a disk to the packing-bars. A lever imparts rotary motion to the disk and an automatic stop prevents the disk from rotating and expanding the packing-bars when the door is open.

TRACK-SANDING APPARATUS.—ALVA A. LINDLEY, Oskaloosa, Ia. The apparatus provided for by this inventor consists of improvements formed as a part of an ordinary valve by which an air-blast may be used for discharging the sand when desired, without interfering with the ordinary manner of operating the valve. The device has its valve pivoted upon the bottom and within the sand-box, and adapted to cover the discharge-opening. A hollow journal on the valve extends through the bottom of the sand-box and has air-connections thereto. The valve has a passage connecting the discharge-opening with the sand-box interior and connections from the hollow journal into the passage.

RAILWAY-TIE DISTRIBUTER.—CALEB C. GATES, Forsyth, Mont. In this apparatus a suitable supporting frame is provided which is adapted to be mounted on the tie distributing devices. In this frame, transverse supporting rollers are journaled at predetermined intervals, upon the frame, discharge rollers are journaled extending longitudinally. Near the longitudinal rollers a number of tripping devices are arranged to divert the ties at these points and cause them to be discharged on the supporting frame.

RAILWAY-CROSSING GATE.—CHARLES R. WOODWARD, Campbell, N. Y. The purpose of the present invention is to provide a safety-gate for railroad crossings which, by simple mechanical means, automatically opens and closes the gate, thus dispensing with the services of a gateman. As a train approaches a crossing, a tappet-roller on the locomotive engages with a projection on a shifting-bar, placed at a distance from the crossing. During this movement a locking-bar, forming part of a connection between the shifting-bar and swinging-gate of the crossing, is moved to its locking position with a boxing in which the locking-bar is movable, by means of a weight attached to a cable running over a wheel mounted on a shaft rearward of the shifting-bar. This operation causes the cable to unwind, so that the gate may move downward to its closing position. As the engine reaches the crossing, a roller engages with a tripping block and, by forcing it upon its fulcrum, causes the boxing of the locking-bar to move out of engagement with the bar. The parts will then be moved in the opposite direction, causing the gate to open.

Miscellaneous Inventions.

ACETYLENE GAS GENERATOR.—CHARLES KELLY, Passaic, N. J. In this invention improvements have been devised whereby the lime hydrate is automatically removed from the generator to keep the flow of water unobstructed. Should the pressure become excessive, the gas is allowed to escape to the open air before the water-seal in the tank is broken. The generator containing the calcium carbid has an inclined bottom discharging into a settling-chamber for the calcium hydrate. A removable cover is provided for the generator and is so arranged as to open the outlet-valve of the settling chamber automatically when the cover is opened. By this arrangement the water is allowed to drain from the generator, leaving behind the calcium hydrate, which discharges into the settling-chamber. In the water-tank, a water pipe extends into the lower of two compartments formed by a diaphragm. A vent-pipe also extends into this lower compartment, the lower end of which pipe is above the lower end of the diaphragm-pipe. A water relief-pipe leads from the vent-pipe into the upper compartment for discharging the water contained in the vent-pipe back into the tank to free the vent-pipe for the passage of air or gas.

INKING-PAD.—JONATHAN H. MELVEN, St. Louis, Mo. To provide a pad which may be supplied with fresh ink so that the ink shall be drawn from the bottom of the pad upward, this inventor employs a box having an upwardly-extended threaded collar attached to its bottom. A block surrounds this collar within the box and has ink-reservoirs in its upper-surface. Another collar fixed in the block surrounds the threaded collar and extends to the top of the ink-reservoirs. A screen covers the block and above it is placed an absorbent pad. For the threaded collar a closure is provided. In filling the reservoirs, the pad is turned bottom upward. The ink poured in, spreads between the pad, filling the orifices in the screen and the space between the screen and block. The second-mentioned collar prevents the ink from flowing into the opening surrounding the threaded collar.

BAG-HOLDER.—WILLIAM D. GRAVES, St. Ansgar, Iowa. This holder is provided with a tightening device which draws the mouth of a bag firmly in place on the bag-support. A hopper or spout forming a support for the bag has an open lower end around which the mouth of the bag may extend. Bearings are attached to the hopper or spout and a vertically-extending pin is mounted to turn in the bearings and has its lower end extended into proximity with the mouth of the hopper. The lower end of the pin is provided with a slot capable of receiving the edge of the bag's mouth, so that upon turning the pin the bag is twisted around the pin and contracted over the lower end of the hopper.

REVERBERATORY SMELTING-FURNACE.—HENRY L. CHARLES, Butte, Mont. With this furnace, molten floating slag may be quickly and conveniently removed without chilling the molten metal. The furnace has an elongated hearth, one of the side walls of which has a centrally-located slag-discharge orifice. The other side wall has a number of twyer-openings. A series of twyers are projected through the twyer-openings, the twyers being angularly disposed to one another and each radially from the slag-discharge orifice. By this means, the blast from the twyers is directed to and concentrated at the slag-discharge orifice.

PROCESS OF PHOTOGRAPHING IN COLORS.—VALENTIN VAUCAMPS, Paris, France. The inventor applies to a backing a series of sensitized layers of different colors in their proper order. He then exposes the layers to light under a negative to render portions of the layers insoluble, washing the picture with an appropriate solvent to produce a relief on its front or exposed face. The picture thus obtained must be viewed by reflected light. In order that the effect of the natural colors may also be produced by transmitted light, the inventor presses the exposed face of the picture against a glass plate, thus destroying the relief and bringing it out on the back. The projections on the back are then removed, and the resulting picture may be viewed by transmitted as well as reflected light.

ASSAYER'S FURNACE.—JOHN J. LONERGAN and ALBERT C. CALKINS, Los Angeles, Cal. It is well known that when highly volatile hydrocarbons, such as gasoline, are employed as fuel in muffles, the oxidation of the charges is defective, so that cupellation is practically impossible in a large portion of the muffle and is effected slowly even in the remaining portion. In order to effect a more rapid cupellation, these inventors have devised a furnace having a rear horizontal passage, the muffle having a rear opening registering with this passage. A main flue and oxidizing attachment are provided, consisting of an exterior pipe connecting the passage and main flue. By this arrangement, more oxygen is admitted, thus causing the cupel charges to be rapidly and effectively oxidized.

FINGER-RING EXHIBITOR.—MARCELLUS ADAMS, West Plains, Mo. This device is designed to take the place of the ordinary ring trays used by jewelers for the display of finger-rings. The device is to be made in sections and screwed down into the bottom of the trays, thus serving to hold each ring in a position in which it is fully exposed for examination and yet clamping and securely holding it in place.

FOLDING-UMBRELLA.—MILTON R. STUDAMS, Bridgeton, N. J. The umbrella patented by this inventor is of larger size than ordinary umbrellas. The stick and ribs may be so adjusted as to enable one to fold the umbrella to half the length of the stick and length of the ribs. A large umbrella may be reduced to such size as to be conveniently used as a walking stick. The stick is formed of telescopic sections adapted to be locked together when extended. The upper section is provided with a runner spring retaining-catch. The lower section of the stick is longitudinally slotted to receive this runner-retaining spring-catch of the upper section.

VEHICLE-WHEEL.—MATHEW M. RENN, Louisville, Ky. The purpose of this invention is to provide a wheel of comparatively simple construction which shall have all the springing or yielding qualities of a pneumatic-tired wheel, but which shall be free from the disadvantages of a pneumatic tire. The wheel has a casing and two series of yielding supports in the casing, the supports of one series alternating with the supports of the other series and extending in the opposite direction. A longitudinally sinuate spring-plate extends through each series of supports and a tie band extends through all the supports of each series. By reason of this construction it is evident that under pressure the spring-plates and the band will yield together and distribute the pressure evenly.

Designs.

PUZZLE-BOARD.—HENRY C. FINCKE, New York city. This puzzle-board represents the harbor of Santiago with its channels overtopped by mountain ranges. Five indentations inside of the harbor represent the anchorages of the Spanish fleet; another indentation in the channel represents the place where the "Merrimac" was sunk. Outside of the harbor five more indentations represent the position of the American fleet. The ships of both fleets are represented by differently colored balls. The eleven balls are started on the ocean side. The board is then tilted in such a manner that the balls representing the Spanish fleet, the "Merrimac," and the American fleet shall each in turn fall into their respective depressions.

CHARM.—JAMES F. PRICE, Boston, Mass. The leading feature of this design is a horseshoe, within which is a transparent panel decorated with a spray of shamrock.

LEGGING.—ARTHUR S. HUNTINGTON, Omaha, Neb. In this legging stiffening bands, circular in shape, are arranged opposite each other on the inner and outer faces of the heel of the legging. These bands are at their bases embraced by a binding strip. The resulting legging is hence better protected on its wearing portions than heretofore.

TRIMMING-BRAID.—HUGO MAUL, Rahway, N. J. This design consists of a body, across the face of which extend obliquely raised and spaced ribs interlocked at their ends in borders corrugated transversely, the corrugations being at angles to the ribs.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for 10 cents each. Please send the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

DIE FABRIKATION KÜNSTLICHER PLASTISCHER MASSEN sowie der künstlichen Steine, Kunststeine, Stein- und Cementgüsse. Von Johannes Höfer. Vienna, Budapest, Leipsic: Verlag von A. Hartleben. With 54 illustrations. Pp. 368. Price $1.15.

Among the industries which have sprung up within the last few decades, the manufacture of plastic materials has assumed considerable importance. The work which now lies before us is entirely devoted to the technique of plastic materials. After a brief introduction, the author exhaustively treats the necessary preparations, the mixing and pulverizing apparatus, boilers, presses, moulds, and other appliances used in making plastic masses. He then passes to the production of materials made of lime, gum, resin, etc., and to the manufacture of papier maché and paper compounds in general, the latter being of particular importance nowadays. Materials composed of wood and cellulose occupy a considerable portion of the volume. After these are described compounds of zinc chlorid, magnesia, sulfur and soluble glass, substances made of various waste products and the making of plaster casts. Cements and artificial stones are also discussed, as well as insulating and refractory materials. The work has covered the entire field of plastic substances and deserves much praise for the painstaking method in which the subject has been treated.

ANLEITUNG ZUM ENTWERFEN UND ZUR STATISCHEN BERECHNUNG GEMAUERTER SCHORNSTEINE. Ein Anhang zu Heft III. des Buches "Der Schornstein Bau." Von Gustav Lang. Hanover: Helwingsche Verlags-Buchhandlung. 1898. Pp. 25. Price 50 cents.

THE MANUFACTURERS' EXPORT CODE. By Charles L. Seeger. New York: United States Industrial Publishing Company. 1898. Pp. 600. Price $10.

There is nothing which tends to decrease modern business expenses like a well arranged telegraph code. The present volume is most admirable and seems to include code words for almost every possible sentence which would be apt to occur in the ordinary transaction of business. The pages are large and well printed and the systems used are most excellent. It should be said that the Spanish translations of sentences, etc., render this book of the greatest possible value for use in business with Spanish-speaking countries. While not an alphabetical code, the arrangement and classification of the different subjects render it quite as convenient for quick and effective use. The excellence of the code is shown when it is stated that one word ("insanos") gives an order for five hundred reels of four-point thick-set galvanized barbed wire.

STANDARD FORM OF PROGRESSIVE QUESTIONS AND ANSWERS ON THE AIR BRAKE. As adopted by the Association of Railroad Air Brake Men at their third annual convention, held in Boston, Mass., April 14, 15, 16, 1896. Pp. 80. Price 25 cents.

SPANISH-AMERICAN CONFLICT MADE PLAIN. Shewey's complete, official, handy reference pocket atlas and cyclopedia containing authentic historical information and statistical tables of reference relating to the Spanish-American conflict, with official maps. Chicago: A. C. Shewey. 1898. Pp. 74.

INTRODUZIONE ALLO STUDIO DEI SILICATI. By Dr. Ettore Ricci. Milan: M. Hoepli. 1898. Pp. 106. 8vo.

Notes & Queries

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(7477) A. G. asks: Would you be so kind as inform me which is the best method of hardening plaster casts (in my case a medallion) in imitation of Parian marble? A. To Make Plaster Casts Hard.—To a thin milk of lime or lime water add 10 or 15 drops of liquid silicate of soda for every pint of fluid used; this is then thickened with plaster to a thick cream. Plaster thus prepared will set in five minutes or thereabout, according to the thickness of the cream. If too much silicate is used, the soda will effloresce on the surface, and spoil the sharpness of the impression. When the cast is already made, it may be soaked for a few hours in a hot, rather thin solution of gelatine, to which has been added a preservative, such as oil of cloves or carbolic acid, and then dried.

(7478) H. H. asks: Can a current of electricity flow past a current coming in the opposite direction on the same wire? A. Two currents of electricity can flow on the same wire, either in the same or in opposite directions. If two equal currents are flowing in opposite directions, one will exactly balance the other and it will appear as if no electricity were flowing in the wire. This is just the same as if a man was carried north on an ice field as fast as he walks to the south. He would not apparently be moving at all. But if one of our currents of electricity is stronger than the other, there will be a current in the wire equal to the difference between the two and in the direction of the greater. Thus if 10 cells of battery are attached to a line, 6 faced one way and 4 faced the other, the line will seem to be carrying the current of 2 cells in the direction in which the cells are sending their current.

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE.

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